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The AUTOMOBILE

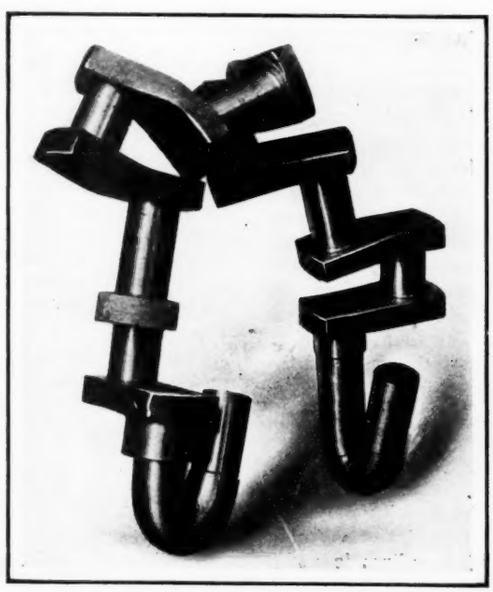
Vanadium—A Vitalizer of Steel

Mined in the Clouds, the Element Finds Its Way Into Automobile Axles, Crankshafts and Springs

By J. Edward Schipper

A VANADIUM steel axle can be tied in a knot without breaking. Any mechanical handbook will tell you that the effect of vanadium on steel is to increase its tensile strength and its elastic limit. Furthermore it will tell you that the use of vanadium in proportions of from .16 to .25 per cent. gives the metal the valuable property of resisting, to an unusual degree, repeated stresses.

No piece of machinery has so called upon the efforts of science in the production of metals as the automobile. In the search for the dual qualities of lightness and strength the value of every known alloy has been tried to the utmost, and nowhere has success been met with in a more gratifying manner than in the use of the alloy, vanadium. For springs, axles and gears subjected to hard service and for parts which must withstand the stresses of vibration and the tendency of crystallization, vanadium steel has been called upon to assume the post of responsibility.



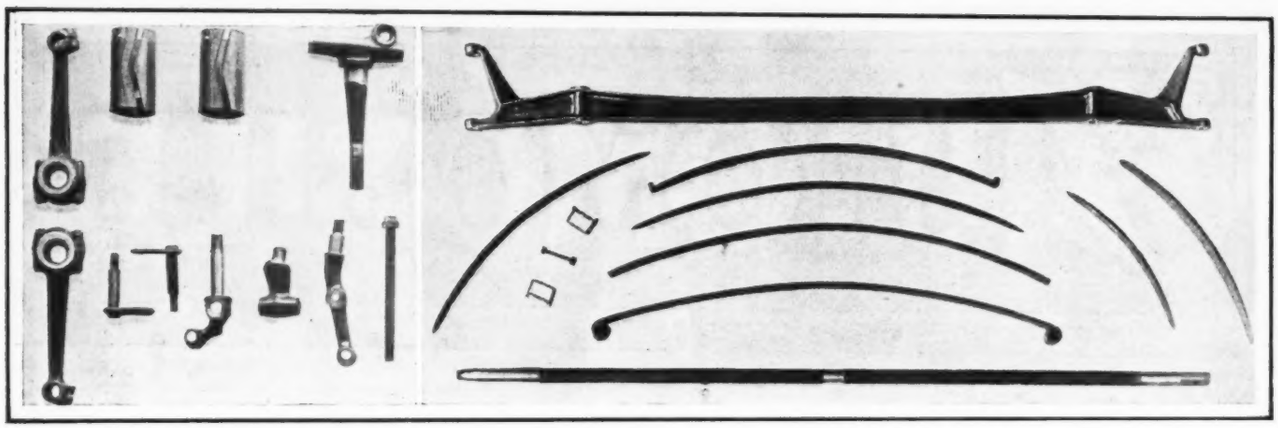
A vanadium steel crankshaft bent while cold

A Hundred Years Old

A little more than a hundred years ago, in 1801, M. del Rio first mentioned the metallic element, vanadium. So elusive was the newly discovered metal that it was but a short time later when he doubted his own discovery and believed that what he had thought to be vanadium was nothing but an impure chromium. In 1830 N. G. Sefström discovered traces of the vanadium content in the slags of the Taberg iron ores. Finally, Sir H. Roscoe managed to segregate the element from its impurities and to determine its correct atomic weight and to place it in its correct group in the series of elements. He incidentally showed that what previous investigators had thought to be vanadium, was merely a nitride or oxide of the element.

It was not until very recent times that the use of vanadium in combination with iron and steel began to be a commercial enterprise of success. In the accompanying chart on page 566 the popularity of vanadium steel in recent years is clearly shown. More than twenty-three times the quantity of vanadium is used for this purpose than in 1908. It cannot be gainsaid that the automobile industry uses a large percentage of the total output. The Ford car, for instance, uses vanadium steel throughout the motor and entire chassis. And this is only one of the representative concerns which have found this alloy to be of use in the parts subjected to the severest strain.

Vanadium is a metallic chemical element. That is, it cannot be subdivided further into components. It is a light-colored material of 5.5 specific gravity, in other words, weighing 5.5 times as much as an equal volume of distilled water. A cubic foot of vanadium weighs 343.2 pounds. A cubic foot of aluminum weighs but 159.7 pounds; water, 62.5 pounds; cast iron, 450 pounds; lead, 709 pounds and iridium, 1,400 pounds. From this it is shown that vanadium is a comparatively light metal and hence, would tend to lighten rather than to make heavier the steel with which it is combined. The percentage of vanadium added to the ladle averages about .15 per cent. and hence, the weight is not



A few of the vanadium steel parts used in the Ford car. Many more parts of this alloy steel are employed

Llamas transporting the ore from the Peruvian mines

greatly affected either way in making up the alloy steel.

While vanadium ores are found in the United States, the largest company operating in this country is using the ore from the mines of Peru. In America the principal deposits are found in Colorado and Utah and recently a deposit of vanadium ore has been discovered in California. The ores of America are known as vanadite, mottramite, descloizite and roscoelite. It is also found as a constituent of various clays, iron ores and pitchblendes. The ore which is found in Peru and which has a far larger percentage of vanadium than any that is found in the United States is known as patronite. The color of the ore is brighter than that of the ore of Colorado and Utah and carries as much as 50 per cent. vanadium oxide. The patronite, the main source of vanadium mineral, is greenish black and has a hardness of 2.5 and a specific gravity of 2.71. It contains from 19 to 24 per cent. of vanadium oxide, while the miners in the Colorado and Utah mines have a hard time in securing ore valuable enough to ship for refining purposes and yet anything which contains more than 3 per cent. of vanadium is worth shipping.

Some of the physical qualities of vanadium which are of note are that it is not volatilized, even when heated to redness in a current of hydrogen and it is insoluble in hydrochloric acid. It precipitates platinum, gold and silver from their salts when in solution.

Ores in the Mountains

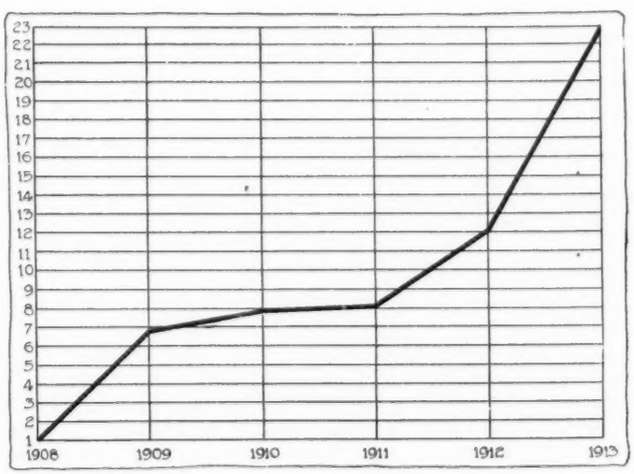
In the United States the ores are found in the higher plateaus of southwestern Colorado and southeastern Utah in the form of soft sandstone. The same ore from which vanadium is extracted is also the source of supply of a large percentage of the world's supply of the rare metal, radium. In fact, much of the ore has been mined for the purpose of extracting this rare substance and only that having the largest percentage of vanadium has been used for the purpose of securing the latter metal. The ore known as roscoelite comes from Placerville, Col., and on the north side of the San Miguel river, between Sawpit and Placerville.

The ore is generally found lying on one or both sides of a parting in the sandstone and in most places the vein is less than 1 inch thick, consisting of roscoelite and a little quantity of quartz which often carries as much as 8 per cent. vanadium. The ore has to be then very carefully selected so that it gives at least 3 per cent. of vanadium. By far the largest part of the vanadium-bearing rock in this country carries less than 1 per cent. vanadium. The ore is often found as vanadinite in fine crystals in combination with other minerals such as lead and copper.

Rich Ores in Peru

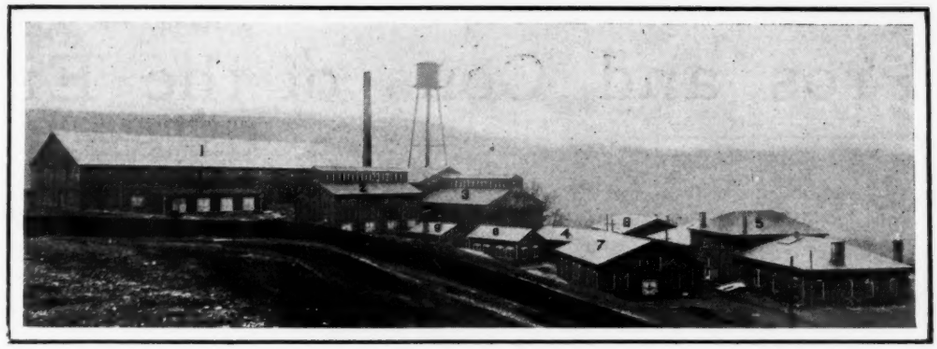
The American Vanadium Co. in 1905 located the rich deposits of vanadium sulphite ore in the Peruvian Andes. These deposits are located at almost the very topmost point of the mountains, being 16,200 feet above sea-level, and establishing the site of what is probably the highest factory in the world. The buildings of the main plant in Pittsburgh are illustrated. There is an ore-storage building, the interior of which is also shown and the furnace and reduction plants are also completely outfitted at the top of the mountain. The ore is named patronite afer the name of the original discoverer of the Peruvian deposits, M. Antenor Riza Patron.

Four reverberatory roasting furnaces are used for reducing the ore at the mines, and in this form it is transported on the backs of llamas to the railway which is 28 miles distant. The nearest point to the mine is Fernandini



Curve showing increase of vanadium steel using 1908 as a unit

station on the Central Railway of Peru. From this point it is taken to the coast. It is stated that each llama will carry a 110-pound sack of the ore and if as much as a pound or two of extra weight is added to the burden the animal will refuse to move. In building this plant on the top of the mountain, the American Vanadium Co., which owns the mines, states that every brick had to be carried to the factory site on the backs of the patient beasts of burden before the factory could be built.



American Vanadium Co.'s plant near Bridgeville, Pa. 1—Ore storage building. 2—Furnace building. 3—Reduction building. 4—Crusher building. 5—Office and alloy building. 6—Storehouse. 7—Machine shop. 8—Carpenter shop. 9—Blacksmith shop. 10—Brick storage building

Coming down to the use of vanadium in the manufacture of modern machinery, it is found that it is in parts subject to the racking and pounding of travel, that it finds its principal use. For this reason it is not surprising to find that it plays a prominent part in the manufacture of locomotives and automobiles. In the framework of locomotives which are subject to the stresses of the huge driving forces, vanadium steel has proven a success. On the Chicago, Rock Island & Pacific Railway, there are thirty locomotives, each weighing 281,500 pounds, all of which are equipped with vanadium steel frames. On other locomotives the axles, crank pins, and side rods are of this metal. On the Baltimore & Ohio road a 462,000-pound locomotive is using heat-treated vanadium steel tires. The elastic limit of heat-treated carbon steel generally averages from 50,000 to 55,000 pounds per square inch. That of chrome-vanadium steel forgings will average from 80,000 to 90,000 pounds per square inch.

By the adoption of heat-treated chrome-vanadium steel frames for their London type busses, the Fifth Avenue Coach Co., of New York City, states that it has overcome considerable trouble that it was experiencing with frame fractures. Previous to using the vanadium steel, this concern used a high-grade carbon steel, heat-treated, but with this, frame trouble was experienced from breaking and also from the fact that the side members would take a permanent set.

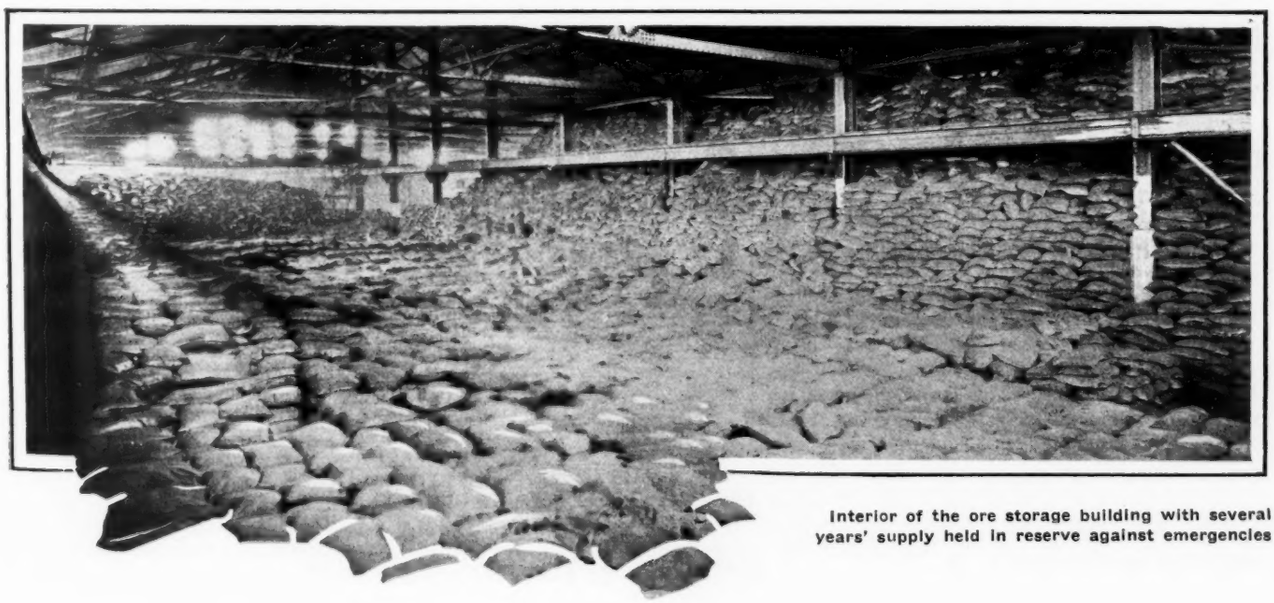
Used in Truck Frames

The vanadium steel frames have been in use in this service for over a year now and the company reports that they have so far shown no signs of bending or breaking. The main frame, complete with the engine cradle is made of chrome-vanadium steel. The construction consists of riveting two vanadium steel plates 15-64 inch in thickness, with an ash filler 1 3-16 inch thick between. The vanadium steel is heat-treated and has an elastic limit of 95,000 pounds per square inch, a tensile strength of 120,000 pounds per square inch and an elongation of 18 per cent. in 2 inches. In weight, the vanadium steel frames are slightly lighter than the carbon steel frames previously used. The total weight of the old frames with engine cradle and feltings, was 865 pounds, while the weight of the new frames is 850 pounds. Thus, by the use of vanadium steel a much stronger frame has been secured, not only without any increase but with a slight decrease in weight.

The American Vanadium Co., which has its general offices in Pittsburgh, has a reduction factory at Bridgeville, Pa., about 12 miles from Pittsburgh. After being transported on the backs of several thousand llamas on the trails of Peru, then being transported by freight car to the coast and by steamer to America, the reduction process is given in the Bridgeville factory. This plant is designed and equipped to produce 30,000 pounds of ferro-vanadium a day, and it is in this form that it is added to the steel.

In the form of ferro-vanadium, or vanadium mixed with iron, the alloy is sold to the steel manufacturer and by him it is put into the steel to meet the requirements of the manufacturer. For automobile manufacturers the Society of Automobile Engineers has specified chrome-vanadium steels

(*Continued on page* 575)



Interior of the ore storage building with several years' supply held in reserve against emergencies

Pros and Cons of the Eight Motor

Lighter and More Economical Than Six-cylinder — Ultimate Type Except for the Small Four

By OWEN THOMAS

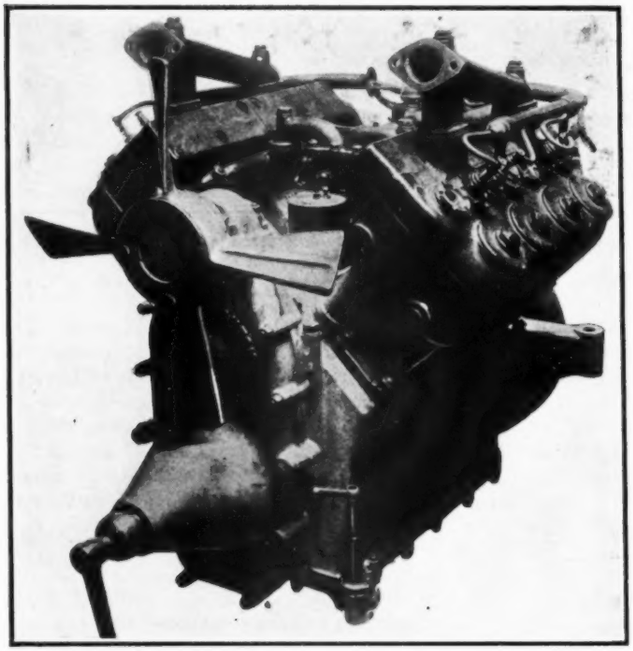


Fig. 1—Eight-cylinder De Dion motor of 30-horsepower. This is a 1911 model but is the same as the present design except in minor details

EDITOR'S NOTE—This article by Owen Thomas, of the engineering firm of Thomas & Thomas, Kenilworth, England and New York City, is based on an analysis of the De Dion eight-cylinder motor design extending over a period of more than 3 years. Mr. Thomas tries to show in this first article of a series that the four-cylinder motor design inevitably leads to the small-bore high-speed, high-efficiency four-cylinder car of Europe and that these principles can only be applied to larger motors by the use of eight cylinders. This is the most complete article that has been printed in an American journal on the subject of high-speed, high-efficiency motors by an engineer who has had actual experience with these motors in Europe.

FOUR-CYLINDER motors of maximum efficiency and horsepower for a given size and weight can not be built with a bore much exceeding 3 inches, if extreme durability is desired. Since the bore is thus limited, an increase in power calls for the addition of cylinders. The six-cylinder motor weighs more per horsepower and entails a longer and heavier car. The eight fulfills the demand for a motor of more power, because it weighs, if anything less than the four and is as efficient as a four of the same power.

Before attempting to prove the claims of the eight, as to flexibility, thermal efficiency, power output per pound, and durability, a successful motor, the De Dion, that has been tried out for several years will be described in detail, and proof of the excellent wearing qualities of this type of motor will be given. With the details of the eight-cylinder construction thus well in mind, this form of motor will be analyzed and reasons for believing that this is the ultimate type of motor for all, except low-powered cars, will be set down in detail.

It is interesting to note, at this point, that in speaking of the début of the eight-cylinder V-type motor in America few realize that there are running in New York today over 100 De Dion Bouton eight-cylinder cars varying in horsepower from 20 to 50. The first of these cars of 50 horsepower was sold in May, 1909, but it was not until 1911 that the 30-horsepower model made its appearance. The motor of this car had eight cylinders, of 70 millimeters, or approximately 2 3-4 inches bore by 130 millimeters, or approximately 5 1-8 inches stroke.

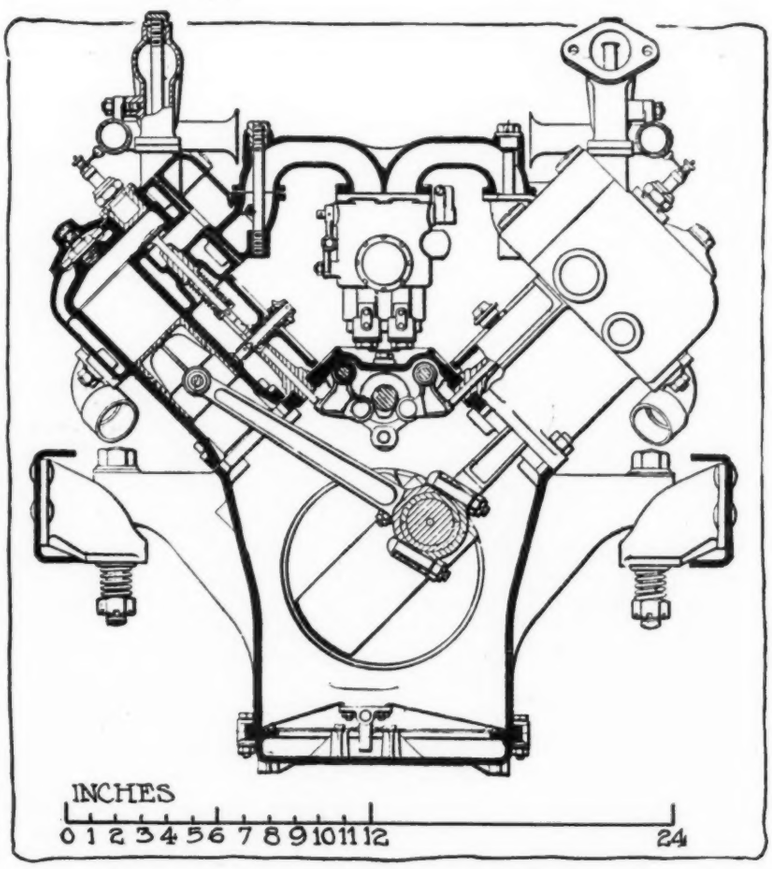


Fig. 2—Part section through motor showing mounting of double carbureter, arrangement of valve mechanism and the connecting-rod construction. Note the springs used in anchoring the motor to the frame

In 1913 this 30-horsepower model was superseded by another of 75 millimeters, or approximately 2 15-16 inches, bore, with the same stroke as before, and a new 24-horsepower model having a bore of 66 millimeters or 2 5-8 inches bore by 130 millimeters or 5 1-8 inches stroke, was added. All of the cars sold, except two, are in the hands of the original owners, these two having been replaced by larger cars of the same make. Last week an effort was made to procure for a Detroit firm one of these worked-in cars but there was not one available.

The beginning of this month saw the taking down and reassembling of the first of the 30-horsepower cars. At the time of this examination the accompanying photographs, Figs. 1 and 4 to 11, inclusive, were made.

First Motor Overhauled

While this motor is not the latest model, it is worthy of close study because it is the first eight-cylinder motor that has been dis-assembled in this country and therefore the only one whose condition is exactly known. At the time it was overhauled it had been driven 32,000 miles with a limousine body. It was found that all the surfaces were in good condition but that the cam and valve mechanism had showed slight wear. This is proof that this type of motor is most durable and improvements that have been made since in this design indicate that this record should be exceeded.

The general form of this motor is shown in Figs. 1, 2 and 3. It is an L-head design with the cylinders placed at 90 degrees and cast in blocks of four. The spark plugs are located over the intake valves and there are removable caps that give access to the cylinder interiors.

The cooling system is thermo-syphon; the water pipes above each bloc taper from 1 3-8 inches inside diameter to 1 3-4 inches inside diameter.

The fan in this model has four blades and runs 1 1-3 times engine speed, while in the later motors it runs with the magneto drive at engine speed and has eight blades.

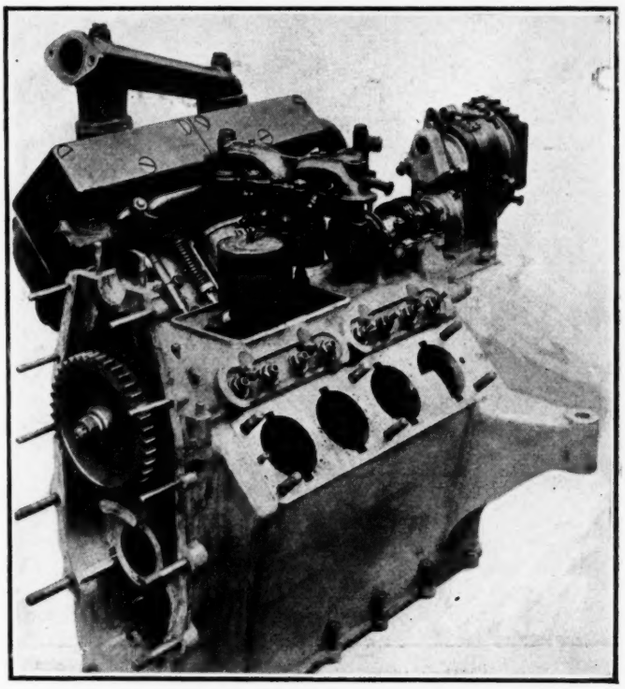


Fig. 4—Motor with left cylinder block and timing gear cover removed

The magneto is a Bosch model H.L. 8. The armature revolves at engine speed, the half-time shaft carries at one end an eight point, high-tension distributer and at the other, an eight point cam, operating a single contact breaker which is carried in a fixed case, giving no variation in the timing of the spark.

The carbureter is carried high between the Vs and connects to the cylinder blocks by means of very short intake pipes. Two separate Zenith carbureters with a single float chamber are employed, balanced throttles being used. This undoubtedly sacrifices the flexibility of the motor to the limitations of the fixed Venturi tube carbureter. So perfect is the balance of this type of motor and so small are the losses that it is more flexible than the carbureter and the difficulty is to find a standard carbureter that will satisfactorily meet the demands of the motor. The intake piping is 7-8 inch.

The depression for the carbureter, Fig. 3, is provided with a copper tube drain cast in, to carry off any leakage of gasoline to the opposite side to that shown.

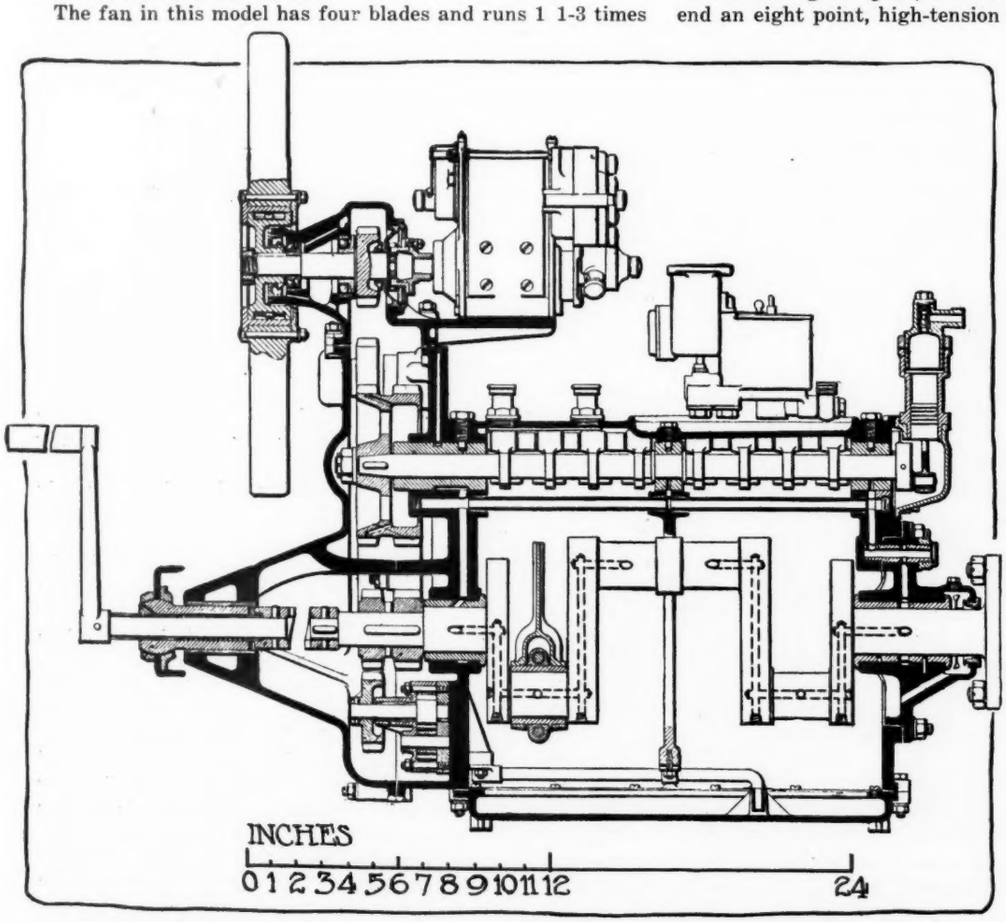


Fig. 3—Longitudinal section through motor with cylinders removed illustrating motor details

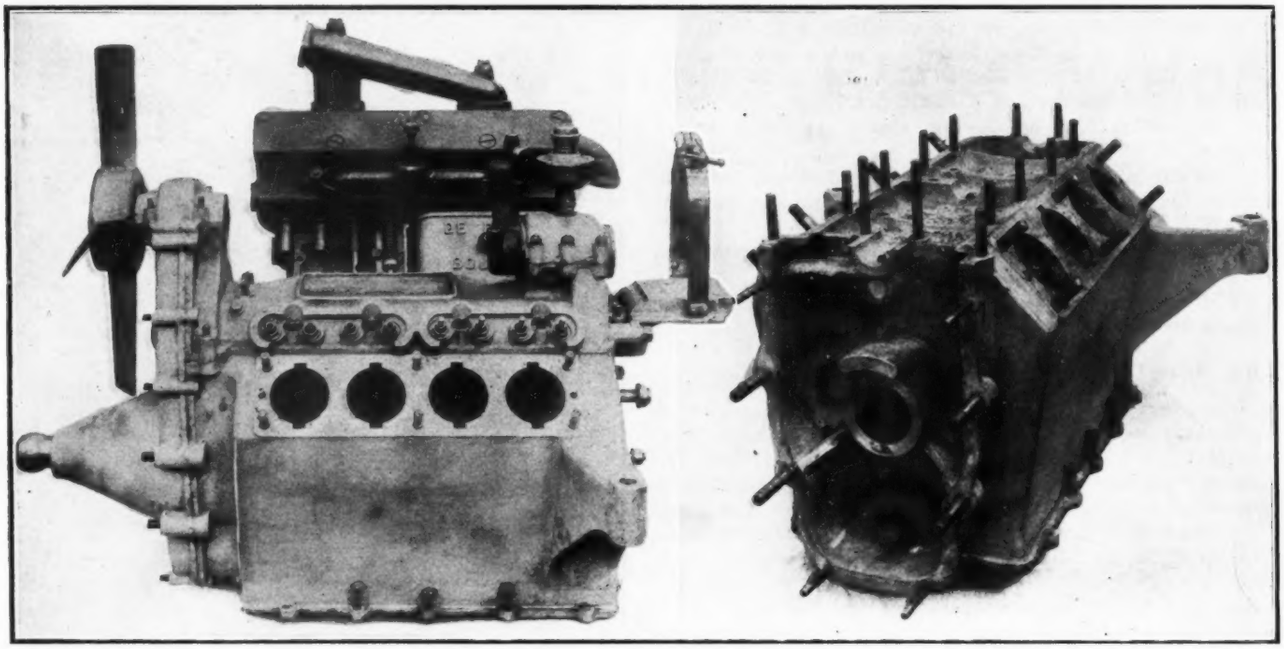


Fig. 5—Left—Another view of the motor with the left cylinder block removed

Fig. 6—Right—Crankcase casting illustrating the studs for holding the parts

The exhaust passages are smaller than usual, 1 1-8-inch pipes from each bloc join together into a common 1 3-8-inch diameter exhaust pipe and a single muffler. Larger pipes would undoubtedly increase the output at high speeds.

Force Feed Oiling

The lubrication system is by force-feed, Fig. 3. The crankshaft is drilled to the pins of cylinders 1 and 2 from the front main bearing, and to the pins of cylinders 3 and 4 from the rear main bearing, the drilled oil holes being 1-4-inch diameter. All the oil holes in the case, including the copper tube cast in, are 1-2-inch diameter inside. The rod bearings are held and pinned in the forked rod. An oil hole through the bronze bearing lubricates the outer surface of the bearing on which the center rod runs between the forked ends of the other rod. The oil thrown from the main and rod bearings lubricates the pistons and other parts. All the camshaft bearings are pressure lubricated. The oil pump running at engine speed has gears 1 3-16-inch pitch diameter, with 12 teeth and 13-16-inch gear face. One gear is integral with the steel shaft, the other is bronze, running on a hardened steel pin which is supported at both ends.

The pump supplies about 20 pounds pressure per square inch at 500 revolutions per minute and about 40 pounds at 1,200 revolutions per minute, the pressure being regulated automatically by the action of a spring valve, shown horizontally, Fig. 6, just under the camshaft bearing. The surplus oil escapes through the two small holes shown in the plunger valve casing and is used for the lubrication of the chain drive. A spring indicator warns of insufficient pressure or oil.

Fig. 10 shows the oil base and screen, the oil pump and suction pipe and the valve-cover parts. The large hole shown in the screen is for the insertion of the suction pipe, the small standpipe at the left is evidently a vent to prevent heavy oil trapping air under the screen.

Fig. 4 shows the cam case cover, one cylinder block and the carbureter, the magneto and air pump in place. Fig. 5 shows the same with the exception of the carbureter and magneto, but with the front chain case and fan cover added.

The bottom flange has 12 bolts and 2 studs, all 8 millimeters diameter.

The upper cam case is held down by fourteen 10 millimeter studs. Fig. 6 shows the oil pockets on top of case into which the cams dip. The hub of the front main bearing is 1-2-inch thick, carrying a 5-16 solid bronze bushing.

The rear flange, to carry the split rear bearing flange, is 13-16-inch thick with 5-8-inch face, Fig. 9. The center web has a hole 7 1-2 inches diameter and is full 3-8 inch thick. The center pad on this web is a support for the oil pump suction pipe. The other two webs die into the case at the side and are tapered down to 1-4-inch at the edges.

Order of Firing

The cam action layout is shown in Fig. 12. The order of firing is:

Right—	1		3		4		2
Left—		4		2		1		3

Reading zigzag: 1,4; 3,2; 4,1; 2,3, first on the right side and then on the left side of the motor. It will be seen that each pair adds to 5 and that unlike the four and six-cylinder motor, they balance equally to the front and rear.

In other words, if any diagonal pair of explosions adding up to 5 is taken, it will be noted that the diagonal drawn between these two cylinders will pass through a point exactly in the center of the motor.

While there are eight possible firing orders there are only two that can be utilized if full advantage of the eight-cylinder principle is taken.

There are eight cams on the camshaft, four for the intake and four for the exhaust. Each pair of four are equally spaced, being set at 90 degrees.

Since the cylinders are set at 90 degrees it is natural to assume that the valve mechanism, Fig. 12, would be laid out so that the cam opening the intake valve on the right cylinder, number 1, for instance, would open 90 degrees after that on left cylinder, number 4. But this is not the case because the camshaft is rotating at half the crankshaft speed —a 90-degree movement of the crankshaft results in only 45 degrees on the camshaft. While the crankshaft is moving 90 degrees the camshaft goes only 45, with the result that in order to open the second valve 90 degrees of crank movement after the first, the spread between the cams must be 90 plus 45 or 135 degrees.

Fig. 12 shows this plainly, the 135 degrees representing the interval between the firing of cylinders left 1 and right 1. On the later type engines the rocker parts are all assembled on the rods and put into the case itself instead of being assembled in the separate cover as shown in the photographs of the 1911 70-millimeter motor.

The rods in various combinations on the crankshaft are illustrated in Fig. 8. The complete twin rods are shown on the rear pin. The complete bronze bearing, clamped and doweled in the forked rod, is shown on pin 3. Small flanges on the bearing, about 1-16 inch wide and high, locate the forked rod on the bearing by fitting between the two sides of the fork. They also serve to take the side bearing of the single center rod and prevent it from rubbing the inside of the forked rod. The outside of the bearing is 58 millimeters in diameter, where the forked rod clamps and the center rod bears. The fit of the center rod is 22 millimeters wide and each side of the forked rod is 16 millimeters wide.

Motor Part Dimensions

All of the shaft bearings are 44 millimeters diameter; the front main bearing and all of the rod bearings are 58 millimeters long; the rear main bearing is 110 millimeters long. The shaft is 54 millimeters diameter between the rod bearings of cylinders 2 and 3.

The crankshaft cheeks are all 64 millimeters wide, the end cheeks are 64 millimeters by 23 millimeters in section and the cross cheeks are 64 millimeters by 34 millimeters in section. The crankshaft is finished all over, the pins and bearings being ground. The side bearing surfaces of the rods present a face 3-16 inch wide. The drilling of the crankshaft is described under lubrication.

The pistons are 84 millimeters long by 70 millimeters diameter. They have three wide rings, all above the piston pin bearing. The pistons are forged and turned out very thin and light. The pins are 12 millimeters diameter; they are held by two taper pointed screws. The bushings are bronze, 34 millimeters long.

The rods are 265 millimeters long on centers for the 130-millimeter stroke. The forked rods have four 8-millimeter bolts and the center rods have two 10-millimeter bolts. The rod sections are 3-4-inch wide on the front and back side near the top and 1 1-8 inch wide near the bottom; the webs and flanges are all 3-16-inch metal tapered to 1-8 inch at edges, the flanges have a total width of 7-16 inch. The caps are 3-16 inch thick in the thinnest place. The split aluminum rear bearing flange has a fairly uniform thickness of 3-8 inch with a gasket face of 5-8 inch. The oil connection shows plainly on Fig. 8. There are four 10-millimeter bolts, holding the two half flanges together, two inside the case and two outside.

The rear supporting arms and the front ball support are plainly shown in Fig. 5. The front weight comes on the chain case cover which is bushed with cast iron to take the steel starting crankholder which is 1 5-8 inch outside diameter, and terminates in a ball joint 2 inches in diameter.

Crankcase Is Strong

The crankcase is very strong and simple, and is an excellent design for cheap manufacture in quantities. It is plainly shown in the illustrations. The general thickness is a full 3-8 inch, the flanges being the same thickness with a 5-8-inch wide gasket face. The cylinder faces are thickened to 1-2 inch over their whole surface and carry six 12 millimeter studs and two dowels. The front chain cover joint which transmits the weight to the front support has four 12-millimeter studs in reinforced bosses, Fig. 6, and eight 8-millimeter studs.

The cam drive details are shown in Figs. 3 and 4. The crankshaft carries two twenty-tooth pinions, one driving a forty-tooth wheel on the camshaft and the other a twenty-tooth wheel on the oil pump shaft which is just below the main front bearing and runs at engine speed. A forty-tooth twin wheel on the camshaft runs the fan, which carries a fifteen-tooth wheel. The magneto is driven through thirty- and fifteen-tooth chain wheels from the rear end of the camshaft.

All chains are 1-2 inch pitch, outside guide link type, Coventry made; the main camshaft chain is 3 by 4 combination, all the others are 2 by 3 combinations. The chains are all in the front case and all but that driving the oil pump are provided with adjusting idlers. A 3-8-inch pitch or 10-millimeter pitch would be much preferable to the 1-2-inch pitch used.

The cylinder center distances of the 70-millimeter cylinder shown are 3 3-4 inches from 1 to 2, 4 inches from 2 to 3, and 3 3-4 inches from 3 to 4. The valves are 1 5-16 inch over all diameter with a clear opening 1 1-8-inch diameter and a lift of 6 millimeters. The valve stems are 7 millimeters diameter. The valves of the 50-horsepower motor have corresponding diameters of 1 5-8 inches and 1 3-8 inches with 9 millimeter diameter stems. The valves of the 70-millimeter cylinder are 75 millimeters centers to the center line of the cylinders. The exhaust bend, Fig. 11, has an inside diameter of 28 millimeters.

Weight of 1914 Motors

The weights of the 1914 motors are, including carburetor and magneto: 20 horsepower, 462 pounds; 30 horsepower, 550 pounds, 50 horsepower, 693 pounds. It was noted that the distances from the center lines of cylinders 1 to 2 and 3 to 4 on the new 24-horsepower engine was 3 1-2 inches, while the distance between center lines of cylinders 2 and 3 was 3 1-4 inches, or 1-4 inch less. This shows that the engine could have larger bore cylinders by increasing only the center distance to 3 1-2 inches. The cylinder castings are much heavier than the standard European design.

The action of this engine and its condition after hard use are a good argument for the adoption of the general two-bearing, eight-cylinder design it follows. Its condition after 3 years of hard service was easily as good as that of a standard four-cylinder American motor after a similar service for one season. In fact, few four-cylinder motors are found in as good repair as this eight-cylinder.

The origin of the eight-cylinder dates back with the De Dion Co. to 1906 when six experimental six-cylinder cars

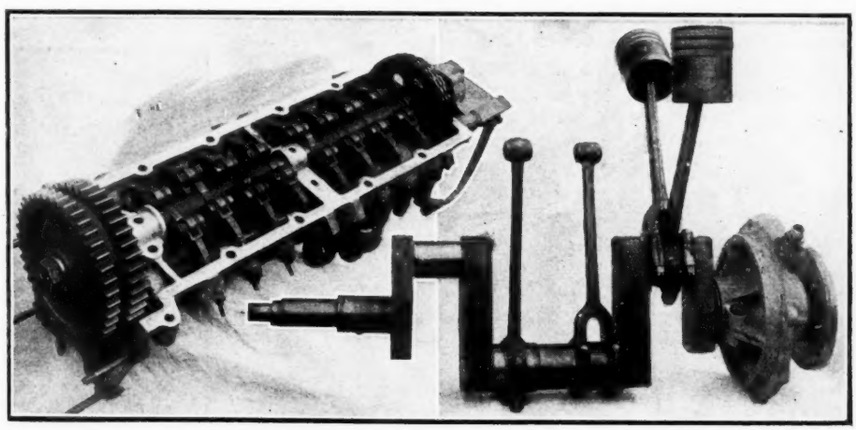


Fig. 7—Left—Camshaft assembly showing cam-roller construction
Fig. 8—Right—Crankshaft with connecting rods partly assembled

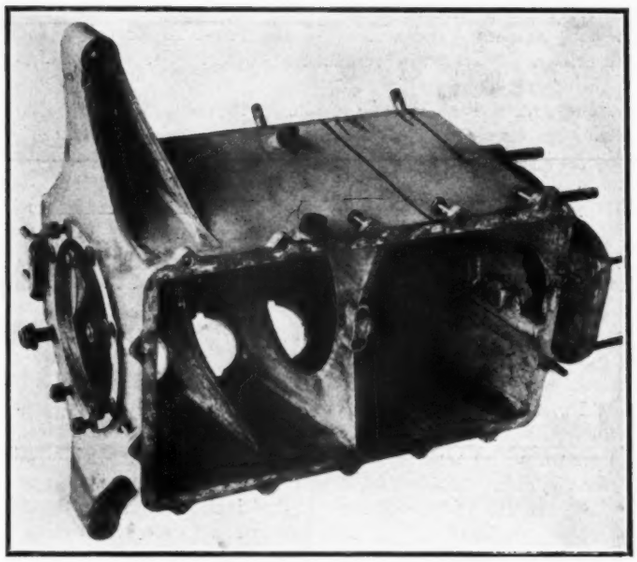


Fig. 9—The crankcase from the bottom showing the method of webbing

and six experimental eight-cylinder cars all of 50 horsepower were built. All of the cars were put on the road and tested for 10,000 miles after which time careful tests and comparisons were made by members from practically all of the departments of the works at Puteaux outside of Paris. The decision was so unanimously in favor of the eight-cylinder cars that the sixes were consigned to storage in a basement until they were finally destroyed by the late floods of the river Seine. This experience is probably unique as the advent of the six-cylinder car in most factories passed without a thought of the possibilities of the eight.

In Europe it cannot be said that the six-cylinder has in any way superseded the four as there are many plants that have never built a six-cylinder and many that have abandoned it with the improvement of four-cylinder design and with the tendency to design lighter and smaller cars for general work. On the other hand, many extremely small sixes are in service, although the performance of the later high-efficiency, counter-balanced four-cylinder models renders them entirely unnecessary. It may be truly said that these small four-cylinder engines and the cars designed with and for them represent the real progress in European automobile engineering for the past 3 years.

Test of Small Four

I started in a serious tryout of this type practically 3 years ago, partly because I did not believe in it and partly because I had to solve some of the manufacturing difficulties of a small car for very little money without an American-sized output to pay for the tooling up. The first year's work resulted in three small cars having 80-millimeter four-cylinder engines. These cars gave the impression of being under-engined except in England, where the roads are particularly good and the hills few and easy. The first remedy was to reduce the axle ratios to slightly lower than 4 to 1 in a car weighing 2,250 pounds, with 34-inch wheels.

Most of the engines of this age and type were designed with a three-bearing crankshaft. When they were new they gave excellent service, but once they began to loosen the bearings, it was difficult to put them back in their original condition. The trouble was naturally sought for in the fact that the engines were proportionately working harder for their size than those in more liberally-designed cars. To make a long story short, it was found to be in the fact that all of the center crankshaft bearings wore out of round on the side furthest from that which would naturally take the thrust of the piston, due to the centrifugal load of the cheeks and pins adjacent to the center bearing. This was plainly shown by the wearing out of the grinder and tool marks, as well as by measurement. The eccentricity of the shaft spoiled the alignment of the bearings whenever they were rescraped and caused the most mysterious roughness. Various expedients, as the stiffening up of the shaft and the crank cheeks and the strengthening of the crankcase and even the use of cast-iron crankcases proved of no avail, and it was not until the advent of the counter-balanced crankshaft that the first of the small type motors was successful. During these troubles much was accomplished by the use of steel and alloy pistons, by the lightening up of working parts generally, by the lengthening of the wearing surfaces of the pistons above the wrist pins and by removing the oil grooves from bearings and generally improving lubricating systems. Some of the engines were of the Knight type; the development of these proved to be of especial interest.

It was not until the year after, that it began to be realized that for the same weight as one of these counter-balance three-bearing crankshaft engines a still more compact two-bearing type could be built as the two-bearing crankshaft is inherently counter-balanced, except perhaps for a very slight projection of the two end cheeks. These two-bearing motors were of a much more refined type than the previous two-bearing motors of France, and on account of their smooth, light running at speeds the sizes were generally reduced to 70 millimeters, and in some cases even smaller bores. These later motors maintained their torque both at very low and very high speeds and gave none of the evidences of being over-worked, which the earlier motors did. It is quite common to see such cars tried out in France at speeds well above a mile-a-minute. I have myself driven them in ordinary touring, covering 35 miles in each hour for long trips.

Small Four Permanent

There is really no question of the success and permanency of the small four-cylinder car in Europe. The problem appears when the 3-inch bore motor is not large enough to fill the bill, as this may be considered as about the limit of assured success in this type, although from time to time larger motors are built.

For my part, I consider the small six-cylinder motor in exactly the same class as the slightly larger four; the same necessity of counter-balance appears if the engine has to be used at high enough speeds to make centrifugal loads a factor. The four-bearing six presents much worse problems than the three in this respect. In the larger motors I have never found the counter-balanced four less flexible, quiet or smooth running than a six-cylinder motor of the same horsepower, either Knight or poppet-valve. The difficulty of balancing the crankshaft is very great in the ordinary six-cylin-

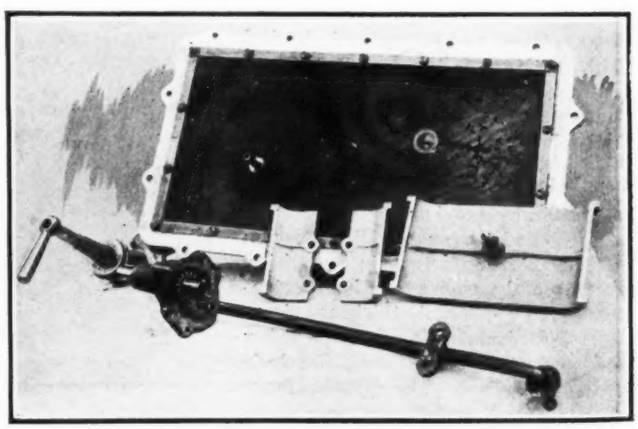


Fig. 10—Crankcase cover and gear oil pump

der and even greater with a counterbalanced shaft due to the springing of the shaft from its own weight during the operation.

What are the problems in replacing a four with a six. A well-known maker with a five-passenger, four-cylinder car wishes to get into the six-cylinder field to supply the popular demand. He is thoroughly satisfied with everything about his car which has been worked down to an economical design in its third season. His six-cylinder motor proved to be 90 pounds heavier than the old four although its flywheel was much lighter. This does not seem very serious. However, he finds it necessary to increase his wheelbase 5 inches to accommodate the longer motor, and here his troubles begin. The longer frame necessitates a deeper section and weights generally go up a little until the tires need to be made a little larger. The motor, moreover, does not show quite the same power or economy as the four-cylinder, although it has to handle the increased weight. The result is that he decides to make it 1-8-inch larger bore and further increase the weight. The motor shows distinct signs of weakness in the crankcase and it is strengthened and made a little heavier. It is thus impossible to make a direct comparison between the old four-cylinder and the newer six-cylinder. A much more satisfactory job could have been made by substituting a more modern four-cylinder engine. Let us suppose that instead of the new six he is willing to investigate the eight-cylinder motor.

Eight Shows Up Well

For his moderate-sized car the eight-cylinder motor of the same capacity can be built with a two-bearing shaft and in less length than the old four-cylinder. It will permit of a slight lengthening of the body space or a corresponding reduction in the wheelbase and weight of the car and even a slight reduction of its own capacity for the decreased weight. These factors together will more than compensate for the slight reduction in thermal efficiency chargeable to the larger cooling area on the greater number of smaller-bore cylinders. This, in turn, will give him the same, if not a greater mileage, per gallon than the original four-cylinder. The tendencies in the six-cylinder design were all against efficiency, as the lengthening of the motor increased the weight and started everything piling up in the wrong direction.

As the cylinders have gradually multiplied, three questions have arisen, first, to what extent does the multiplicity of cylinders and other parts help the flexibility of the motor; second, when does the multiplying of cylinders affect the simplicity and economy of design in general; third, what is the effect on vibration?

The first question of flexibility demands some study. Let us consider a single-cylinder of an engine with cranks 180 degrees apart, as a unit, and take a manograph card of a typical poppet valve motor running at 500 revolutions per minute with the throttle wide open as an indication of the distribution of pressure throughout the working stroke of 180 degrees of the crankshaft when the engine is normally pulling at reasonable speeds. Neglecting side thrust, angularity, friction, and other relative modifying influences and tabulating the pressure times the lever arm for each 15 degrees movement of the crankshaft we will study how much of the stroke of each cylinder is effective.

Degrees of Crankshaft.	Cylinder Indicated Pressure. Pounds Per Square Inch.	Compression Indicated Pressure. Pounds Per Square Inch.	Effective Pressure on Crank.	Relative Lever Arm of Crankshaft.	Relative Turning Moment.
0°	165	0	165	0.	0
15°	210	1	209	.258	54
30°	190	2	188	.5	94
45°	160	3	157	.707	111
60°	140	5	135	.866	117
75°	120	7	113	.965	109
90°	102	9	93	1.	93
105°	88	12	76	.965	73
120°	75	15	60	.866	52
135°	61	18	43	.707	30
150°	50	22	28	.5	14
165°	40	35	5	.258	1
180°	20	60	—40	0.	0

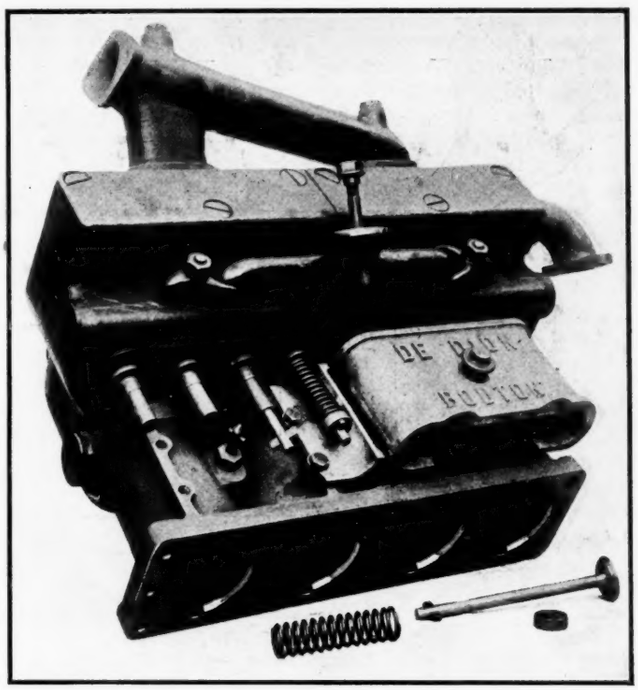


Fig. 11—Right cylinder block with the valves partially removed. The water piping and intake and exhaust manifold are clearly shown

At the upper center or firing point, which may be called, as in the steam engine, the dead center, the pressure contributes nothing whatever to the turning moment of the crankshaft but simply puts the parts under stress and tends to drive the crankshaft out of the bottom of the engine.

After the shaft has turned through the first 15 degrees, the pressures which have decreased but slightly, still contribute little to the turning moment of the crankshaft, on account of the short lever arm presented by the crank at this point.

From 30 degrees to 120 degrees, the turning moment reaches a maximum at 60 degrees and again descends to about the same low point as at 15 degrees. Thus, practically all of the useful work of this cylinder is accomplished between the 30-degree and the 120-degree points of the crankshaft or within 90 degrees. If two or more such cylinders are made to work in succession at 90-degree intervals a fairly uniform turning moment will result although even then the variation in torque amounts to one-half of the maximum.

The smallest number of cylinders that will accomplish this is eight, arranged as a V-type engine. Any smaller number will show a greater variation and depend that much more on the flywheel.

Then the multiplicity of cylinders, up to eight, does help the flexibility of the motor.

Studying the second question: When does the multiplying of cylinders and parts affect the simplicity and economy in general, we find that the eight-cylinder V-type engine with two-bearing shaft has a much simpler crankcase, crankshaft, camshaft and intake manifold than the six-cylinder.

The cylinders are two duplicate bloc castings with an increased number of valves and other parts. The cam rockers are also more complicated and have to be set at 135 degrees as stated in the description of the De Dion motor. The connecting-rods are the real problem, although they present no great difficulty.

The engine is as short as a 4 of the same displacement, providing the crankpin bearing is the same length for a pair of opposite connecting-rods in the eight-cylinder as for a single rod in the four-cylinder.

Two separate designs accomplish this logically and prac-

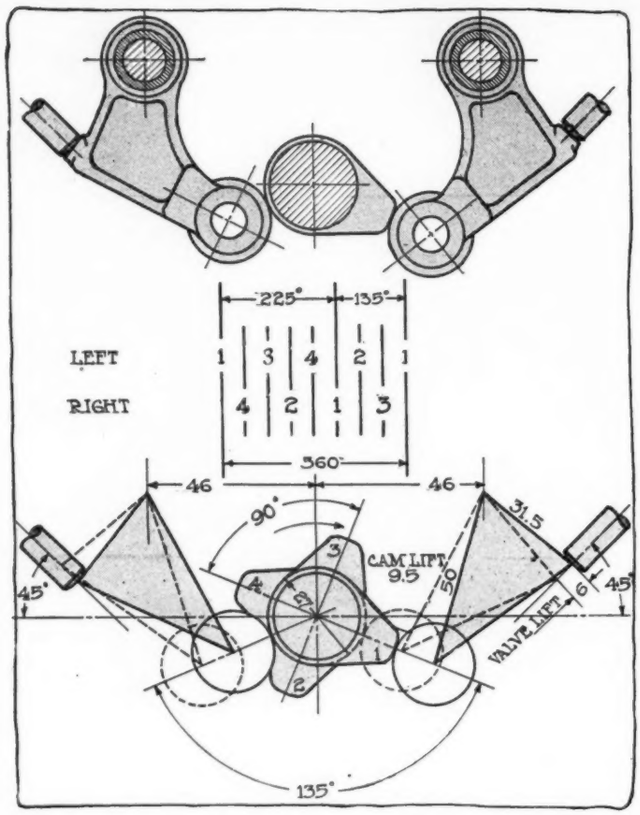


Fig. 12—Layout of valve mechanism showing that the spread between cams of the cylinders firing in sequence must be 135 degrees

tically. In one type, one of the opposing rods is hinged to the big end of the other outside the crank-pin bushing. In the other, as illustrated in the De Dion engine, a single bronze bushing on the crank-pin is used in common for the two opposite rods, one of which is forked to straddle the other. The bronze bushing is held solid in the end of the forked rod and prevented from turning by a dowel in each of its caps, while it is free to revolve or rather rock in the big end of the single-capped rod.

The De Dion crankshaft, Fig. 8, shows No. 1 crank-pin without a rod or bushing, No. 2 with a bushing and a center rod free to rock on it, No. 3 with a bushing dowelled securely in the caps of a forked rod, and No. 4 with both rods.

The placing of rods separately on two crank-pins adjacent longitudinally gives the motor such a length as to destroy its economy of design.

In some instances of four-, six- and eight-cylinder small-bore engines, the bearings at either the top or big end of the rods have been offset longitudinally from the center line of the rod, but these and similar expedients, which result in an unequal distribution of stresses and bearing pressures, do not actually produce economical design; in every such case, a relatively smaller engine designed with all stresses and bearing pressures equalized, will do the same work with equal depreciation and maintenance. I have been connected with many such designs and have kept records of them, covering long periods of operation and test, sufficient to entirely eliminate them from future consideration.

Considering the noise only, the muffling of an eight-cylinder is simple and can be accomplished with a smaller muffler than either a four- or six. In fact, the open exhaust from eight cylinders is not disagreeable. The exhaust valve of any particular cylinder of an eight opens before the exhaust valve of the preceding cylinder has closed, and tends to blow back the exhaust gases of the preceding cylinder to an extent that it is necessary to use either a very liberal muffler or a separate expansion chamber for each block of four cylinders to prevent the next charge from becoming foul with too large a proportion of spent gases. This phenomena appears in many six-cylinder engines where the opening of the exhaust valve exceeds 240 degrees of the crankshaft and has often been charged against the carbureter instead of against the exhaust system. In poppet-valve engines, the area of the valve opening varies directly as the diameter of the valve, for the given lift, while for a given stroke, the cubical contents of the cylinder varies as the square of the diameter; the difficulties of designing the valves of sufficient area of opening, decrease directly as the cylinder bore.

Studying the Third Question of Vibration

Whatever other inertia disturbances, admitted or otherwise, exist in an engine having vertical cylinders, their effect is communicated to the supporting members in the same vertical direction as the stresses due directly to torque reaction. At certain recurring speeds, the periods of vibration due to these disturbing influences, harmonize with those due directly to torque reaction. These speeds are usually designated as critical speeds.

These critical, vibrating speeds can be materially affected by reducing the weight and inertia of reciprocating parts on the one hand and by increasing the number of cylinders and reducing the unit torque reaction on the other, providing the connecting-rods and crankshaft are rigid enough to transmit the intermittent stresses due to inertia and torque, without perceptible spring.

In the V-type motor, having cylinders spaced 90 degrees apart, the inertia disturbances of each side of the engine are still in the line of the cylinder axis. They can be plotted on the sides of a right angle triangle, whose horizontal base or hypothenuse will represent the magnitude and direction of the disturbing stresses due to inertia. These stresses are at right angles to the stresses due directly to torque reaction and can never, at any condition of load or speed, be in phase with them or their harmonics.

This fact applies equally well to any combination of cylinders arranged in a 90-degree V-type engine and explains the success and lack of vibration in the two-cylinder Riley car of England as well as many of the cyclecar engines of this type, in spite of their unequal angular distribution of power.

Advantages of Eight Summarized

The eight-cylinder V-type engine permits equal angular distribution of the power impulses; it has good thermal efficiency, because for a given work, its superior turning moment and more equalized torque permit a smaller engine to be used for the same work; like the small-bore, four-cylinder it permits a short, rigid, self-counterbalanced crankshaft; it has light reciprocating parts with low inertia stresses; it has the immunity from critical speeds enjoyed by all 90-degree V-type engines, and lastly it does not take more space or increase the weight or wheelbase of any car over a four-cylinder engine of the same capacity.

It is surprising how little difference there is either in gear ratio, general design or detail between the modern town car chassis and that eminetly suited for high-speed work. We are gradually beginning to realize that any disturbing forces which mitigate against high engine speeds and spend themselves in vibration are the greatest causes of self destruction, not only in the engine but in every other part of the car.

During the last 6 months the demand from Detroit factories for European experimental high-efficiency cars has been an indicating that considerable study is being applied to this important subject, while the orders appearing on the horizon from the same place since the announcement of the Cadillac eight-cylinder cars threatens to deplete the available stock of eight-cylinder cars which had already been decreased by the European war.

Vanadium—A Vitalizer of Steel

(*Continued from page* 567)

and also nickel-chrome-vanadium steels in which the vanadium content is not less than .12 per cent. An idea of the automobile parts in which this material finds its best use, may be gathered from the accompanying illustration which shows a few representative parts. In one well-known light car it is used for connecting-rods, crankshafts, transmission gears, differential gears, axle shafts, springs, steering knuckles and front axles, besides a number of other small parts subject to wear and shock.

It is not only for vehicles, however, that this alloy has been usefully employed. One of the tools which has the severest duty to perform is the circular saw used for cutting steel rails such as are used for railroads. It is said that these saws cost one-third as much as high speed steel ones and can perform the work as rapidly as the others. Furthermore, the cracking trouble that was experienced with the high-speed steel has ceased with the use of vanadium steel.

Uses a Typical Analysis

It is not alone in automobile engines that vanadium has been successfully employed for internal combustion power plant purposes. The Wisconsin Marine engine has also used vanadium steel crankshafts, connecting-rods, pump shafts and camshafts. The motor particularly mentioned is a 5.25 by 7 six-cylinder marine type and the steel used, a typical chrome-vanadium composition containing not less than .15 per cent. vanadium, .90 per cent. chromium, .65 per cent. manganese and .35 per cent. carbon. The phosphorus and sulphur impurities were kept under .04 per cent. These vanadium steel parts, after their heat treatment, give a tensile strength of 125,000 pounds per square inch. In the automobile racing motors used by the same concern, the same analysis and strength of steel is employed.

Vanadium has been used extensively in brass containing from 50 to 60 per cent. of copper. Its effect is to materially increase the tensile strength of the resulting metal, although in the case of manganese bronze this was at the expense of reduced ductility. The amount of vanadium present is but a trace and micro-photographs show that when the amount of vanadium present is over .5 per cent. there is a slag-like substance which would indicate that above this percentage the vanadium exists in oxidized form.

In a word, we find vanadium used wherever a part is subjected to stresses which would tend to fatigue the metal. The substance which 100 years ago was so elusive that the foremost chemists of the day had difficulty in separating it from its ores, today is one of the factors of making travel safe and economical by increasing the strength of the lightweight parts used in the vital points of vehicle manufacture.

How To Weld Malleable Castings

WHILE the process of autogeneous welding is being used so successfully in all the metal trades, many unsuccessful attempts have been made to weld malleable cast iron, and to those who have experienced disappointment, an explanation of why their efforts failed, with an outline of a method by which these castings can be mended, should be of benefit.

Malleable castings are first made in the condition of hard, brittle, white cast iron and subsequently made malleable by heat treatment. The heating process which converts white cast iron to malleable iron is called annealing, and effects a chemical change in the structure by decarbonization. This decarbonization is nearly complete at the surface and penetrates in a lessening degree toward the center, giving the outside portion the texture of mild steel while the inner portion may retain, in a more or less degree, the qualities of cast iron. When this metal is remelted the carbon is dispersed, and the entire mass reverts to cast iron.

Methods Must Vary with Material

The operator who is used to welding mild steel and cast iron will recall that they are handled differently. That the method used in welding steel to steel would be useless in welding cast iron, or the methods employed with cast iron would be equally unsuccessful with steel. That is practically what he is trying to do when he undertakes to weld a malleable casting. The material is not homogeneous. The bottom portion of the welding being in cast iron, and the top portion in steel, with no definite dividing line between, it is useless to follow the method prescribed for either.

It follows that to successfully mend a malleable casting the process employed must not necessitate the sides of the fracture, that the welding material should fuse at a lower temperature than the casting, and that its adherence, bonding qualities, physical strength and ductility should closely resemble the original casting. After much study and experiment the Vulcan Process Company and their allied interests in Minneapolis are having considerable success in mending broken malleable castings, and a description of their methods will undoubtedly be useful to others who are employed in the metal trades.

In preparing the work for mending, the fracture is chipped away in the form of a V groove with the pointed bottom just coming to the surface on the opposite side, or, if the casting is thick and the opposite side accessible, two grooves are cut with their pointed bottoms meeting in the center. The part surrounding the fracture is then heated with an oxy-acetylene torch to a bright red, and sprinkled with Vulcan bronze flux followed by a few drops of Tobin bronze melted from the welding rod. If the bronze remains in a little globule the work is not hot enough, but if it spreads and adheres to the surface, the temperature is right, and the groove should be quickly filled. It is not advisable to keep the work hot any longer than is necessary, but to make the mend as quickly and at as low a temperature as possible. The behavior of the bronze affords a guide in regulating the temperature. This process cannot be called autogeneous welding, but a malleable casting mended in this way is practically as good as one piece. It has about the same tensile strength and ductility as the original and the process has the advantage of being very quickly performed.—From *The Iron Age*, July 16, 1914.

Rubber Tires Proposed for Street Cars

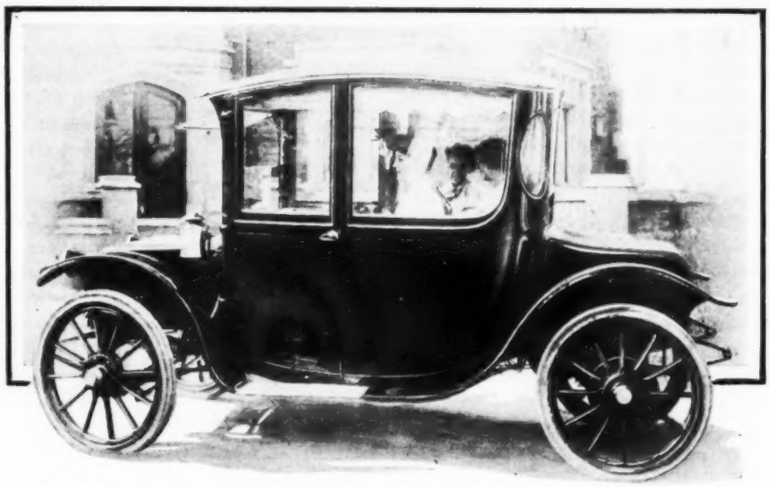
LONDON, ENGLAND, Sept. 20—At the recent session of the Tramways Assn. of Great Britain in Newcastle one of the speakers suggested the introduction of rubber or some other silent material for tires for street cars.

The speaker contended that a properly designed tire for street cars would exceed the life of tires on motor buses and motor wagons, on which a life of 20,000 miles and over was common; that the wear and tear on the rails would be reduced; that the cost of maintenance would be largely eliminated; and that the corrugation problem would be solved.

The question of doing away with noise and vibration, it was contended, was a strong argument in favor of rubber tires. A higher rate of speed could also be attained, which the speaker placed at 20 miles an hour.

More Graceful Lines on New Four-Chair Waverley Electric Brougham

Rounded Corners on Body—Larger Windows With Sashless Frames—Aluminum Body Panels—Chassis Unchanged



New Waverley four-chair Brougham, model 109. Note the rounded corners at the rear and the new shape of battery boxes at front and rear. The windows are larger and sashless

UNDER the model number of 109 the Waverley Co., Indianapolis, has brought out a refined design of electric brougham which incorporates many details new to practice in this field. The new car is fitted with a four-chair body and supersedes the previous body of that type manufactured by this company.

The entire exterior appearance of the body is new. The rear corners are now rounded instead of carried to an edge as in previous models. The battery boxes, still mounted under the front and rear decks, are lower and smaller and have a more delicate curvature. The windows are larger and are now sashless types; oval corner windows are fitted and decorative window shades are factors in the improved and more luxurious appearance of the car.

Four-Chair Seating

The four-chair seating arrangement is continued. By this scheme each passenger has the maximum of knee, shoulder and elbow room and at the same time a wider range of vision. In the construction of the body a new departure for Waverley has been introduced and that is in the use of aluminum. The roof and panels are now of this light metal.

Another feature is the curved sill which gives a low body suspension and yet does not alter the road clearance. The floor is 7 inches nearer the ground than that of the previous design and yet the same road clearance is given.

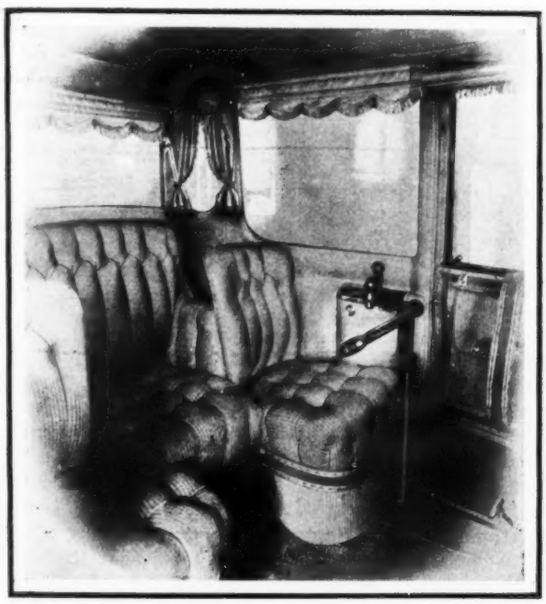
Chassis Details Continued

The same motor is retained, and the same drive and spring suspension. The latter is a feature of Waverley design being a five-quarter elliptic all-around. In the entire spring suspension there are 33 feet of alloy steel distributed among eighty-four spring leaves. Throughout the mechanical parts of the car, standard Waverley practice has not been departed from.

Forty-Two Cell Lead Battery

On the new model the source of power is a forty-two cell eleven or thirteen plate lead battery. Any standard make will be supplied and if the purchaser desires to add slightly to the cost the Edison or Ironclad Exide type will be supplied. The battery supplied is sufficient under ordinary circumstances to carry the car 75 miles.

The Waverley company emphasizes the fact that the ampere-hour capacity is not the true method of measuring the capacity of a battery for purposes of judging the distance that it will propel a car. The true criterion is the watt-hour capacity. This is reached, in the case of a lead battery which measures about 2 volts to the cell, by multiplying the number of cells by two and multiplying this result by the ampere-hours capacity of the battery.



Interior of new four-chair Brougham with left drive. The decorative window shades are a feature

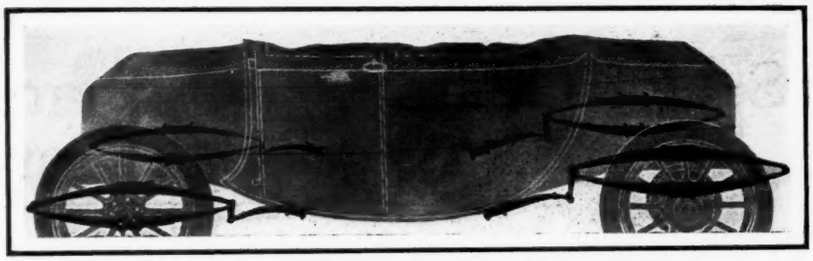
In the case of the Edison battery the voltage runs about 1.2 to the cell. For this reason the number of cells will have to be multiplied by that figure in calculating the capacity of an Edison battery. In fitting the Edison battery at the extra price the company supplies the 60-cell type.

The batteries are carried at the front and rear. The battery boxes are covered by the sloping decks which are rounded off to give a harmonious design. In order that no acid can reach the paint through spilling of the liquid, the battery compartments are lined with acid-proof material.

Knife-Blade Controller

The flow of current from the battery to the motor is regulated through a knife-blade type

of controller. As the handle of the controller, by means of which the driver regulates the speed of the car, is pushed forward, the knife blade switches are picked up one by one. Each blade of the switch is of brass, and the contact is made on both sides of the blade by means of copper blocks which are sprung apart on the entrance of the blade. The springs which hold the blocks tightly against the knife blade are of the finger type and are made from phosphor-bronze. A Yale lock is fitted on the controller handle to guard it against theft. The car cannot be started on any but the lowest speed on account of an interlocking device. The electrical connections are made without any break in the circuit giving a continuous smooth acceleration.



Five quarter elliptic spring suspension which gives all the advantages of the full elliptic and the cantilever, it is stated

Medium Speed Motor Used

A medium-speed, four-pole, series-wound motor is employed in the new Waverley as in all the other models of this make. The nominal speed of the motor is 1,500 r.p.m. This speed has been selected because it is high enough to furnish the high torque necessary in pulling the car through a difficult stretch of road and yet it is not of such high speed that there are material losses through the necessity of a large gear reduction.

The motor has a nominal voltage of 80 and the battery of 84. This allows for a drop of 4 volts in the line between the battery and the motor. As the entire system, especially as regards the controller has been designed to keep the current loss through resistance at a minimum, this allows a good factor of safety.

The motor is suspended from the body just forward of the rear axle and as will be seen from the illustration there are two reductions. The first is through a silent chain from the armature shaft of the motor to a shaft parallel with the rear axle. From the latter shaft the drive is transmitted by means of a silent-herringbone gear to the rear axle. The reduction is such that at 1,500 r.p.m. of the motor the car is traveling at 20 miles an hour.

Floating Rear Axle

The rear axle is floating, the shafts being of 3.5 per cent. nickel steel, heat-treated. One end of the axle shaft floats in the differential and the other is connected to the wheels by a clutch through which the drive passes. The short shaft between the rear axle and the motor is merely a driving member as are the axle shafts. They are not called upon to bear any twisting torque strains. The differential gears and the herringbone drive can be exposed to view by the removal of cover plate from the housing as shown in the illustration.

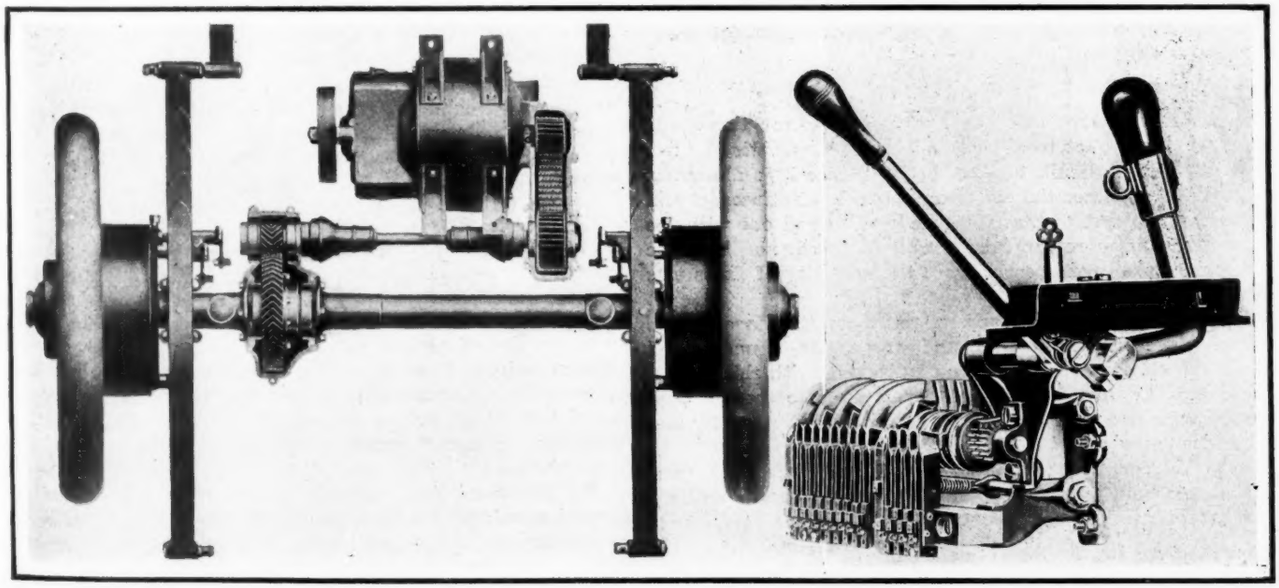
The front axle is an I-beam section of one-piece, drop-forged, steel. The spring pads which carry the full-elliptic springs are forged integrally. A rather unusual feature in axle work is the outward slant given to the steering knuckle and the downward tilt, to counteract this given the spindle. This results in a semi-irreversible steering gear as there is a greatly reduced tendency of a road shock to swing the front wheel about the tilted pivot pin. The steering connections are ball and socket all through. The joints are provided with coil springs to absorb the shocks and they are universal in action. The unassembled view of the axle illustrates the parts.

Trussed Wood Frame

The frame of the Waverley car is a patented feature which ingeniously furnishes a large amount of strength and at the same time forms a good support for the body. A trussed hardwood beam is used. This is brought close to the ground in a graceful sweep providing an entrance low to the ground and yet not lowering the part of the body which supports the motor to such an extent that the road clearance is cut too low.

Both the front and rear wheels are carried on the Timken bearings. Dust caps are fitted over the outside of these

(*Continued on page* 597)



Left—Power plant showing connection of motor with floating rear axle. A double reduction drive is used, the first being through a silent chain and the second through herringbone gears

Right—Controller used on new Waverley. A Yale lock is fitted to guard against theft

Thinks Set of Gears Better than Extra Battery Cells for Starting

The Automobile Engineers' Forum

Engineer Likens Starting a Motor to a Study in Leverages, the Starter Being the Lever and the Gear Ratio the Fulcrum Location

DAYTON, O.—Editor THE AUTOMOBILE:—The question of relative merit of the 6-volt and 12-volt electrical systems for automobiles cannot be answered by stating that either is best. As Mark Twain said, "It is difference of opinion that makes horse races."

The 12-volt proposition at the present time seems to have its strongest supporters among those manufacturers who use a very low gear ratio between the starting motor and the engine, and must, therefore, have greater torque than would be necessary were a higher gear ratio used.

Study in Leverages

Starting an engine can be considered as a simple study in leverages. In the choice of a long or short lever to move a given weight, you must have a heavier short lever and a heavier pull on the end of it than if your lever is longer. In the case of starting an automobile engine, the lever is the starter and the location of the fulcrum is the gear ratio. You can take either a short heavy lever, which is a low gear ratio motor, and a heavier battery to pry the engine loose and keep it moving; or you can use a reasonable gear ratio—a small machine—in which case a light, low voltage battery is ample.

This company is not in the habit of entering any discussions of this type, as we believe no useful interests are served in argument. Our apparatus for any automobile is designed to give the best operating efficiency for that particular case, and we usually design a gear ratio which will crank under the most unfavorable conditions at a good starting speed.

Gears Preferable

If there must be complications in the system, we believe a set of gears, which are idle except at the moment of starting, to be far preferable to a multiple cell battery in which the extra cells are always to be reckoned with in the added space and weight necessary and the additional care which they demand, because for a given weight of battery the fewer the cells the greater the efficiency, and the less care they require.

As far as the lighting proposition goes, the argument is all in favor of the lower voltage.—W. A. CHRYST, Chief Engineer, Dayton Engineering Laboratories Co.

Considers Two-Wire System the Only Logical One

BRONXVILLE, N. Y., Editor THE AUTOMOBILE:—Our company makes a specialty of supplying its lighting and starting system with all the wiring necessary for wiring a car, with the plugs on the ends of the wires, the wires cut to proper length, connected to the switch, etc., so all that our customers have to do is to put these wires in place and fasten the switch to the dash.

Two-Wire System Never Fuses

We will not supply a single wire system for this work, because of the fact that a ground in the single wire system means a short circuit, and as a consequence it is absolutely essential that either the two-wire system or else fuses, should be used. No system that we have ever turned out with the two-wire copper return has ever been fused, nor have we ever known or seen a case where the necessity of fuses was apparent.

The advocates of the grounded return system have always claimed that it was simpler, and was easier to understand than the all copper circuits, but I disagree with this. I believe that any owner will find it as simple to trace a two-conductor cable from his battery to his switch, as to trace a one-wire cable.

The introduction of the fuse immediately entails complications that make the grounded return system entirely too complicated for the average users of motor cars.

Four Reasons for the Two-Wire System

I consider the two-wire system preferable for the following reasons:

1—It is safer—because on account of the elimination of fuses, a single ground will not immediately produce a short-circuit, which will blow out fuses and put out the lights when the car is being driven.

2—It is simpler—on account of the elimination of fuses and fuse contacts which become loose, etc.

3—It is cheaper—on account of the elimination of fuses.

4—The entire history of electrical engineering records the use of ground return systems in each branch of the industry when in its infancy, and then the elimination of the ground return and the use of a copper return finally.—L. KEBLER, President Ward-Leonard Electric Co.

Thinks Lower Upkeep Offsets Extra Cost of Oversize Tires

AKRON, O., Editor THE AUTOMOBILE:—We acknowledge receipt of your letter of the 16th inviting an expression of opinion from us on oversized tires. There has been so much misinformation published regarding so-called "oversized tires" that we are taking the liberty at the outset, of defining the term "oversized tire" when used by us by this statement.

By "oversized tire" we mean a tire that fits a rim of accepted standard size in spite of the fact that the tire is so made that it is 1-2 inch wider in cross sectional diameter than the regular sized tire for that rim. To be specific, we regard a 33 by 4-inch tire as the "oversize" for a 32 by 3 1-2-inch tire. With us variance between a number of different

32 by 3 1-2-inch tires would not constitute one of them as the standard and some of such tires be regarded as "oversize" and others by the same token as "undersized."

It is not promised for oversized tires that they will give more mileage, although in theory perhaps, they should do so. This is due to the fact that we regard mileage as something which is largely within the control of the tire user. We think most drivers are careful of their tires and wear them out rather than otherwise. Consequently, the oversized tire has the opportunity in most cases of establishing its superiority over the regular sized tire.

The strongest defence of the oversized tire that we know of is the fact that no case has ever come to the writer's attention or to the attention of any other tire man with whom I have had the pleasure of discussing this question, of a person who once having used the oversized tire went back to the smaller regular size.

This, we think, conclusively establishes that the oversize is the more satisfactory tire and this satisfaction must, we think, be based largely on serviceability.

A Greater Margin of Safety

The oversized tire having a larger area, manifestly has more material than the regular sized tire and a greater carrying capacity. These two factors result in a greater ability to withstand abuse, ability to do its work with less distortion of the tire, the probability of minimizing trouble from cuts, bruises, etc., and a greater margin of safety. In addition, oversized tires require less air pressure to properly carry a given load and this affords greater riding comfort to the occupants of the car and less jarring and jolting of the car proper and a corresponding reduction in the loosening of nuts, bolts, motor mechanism, etc. This again results in lower car up-keep, which we are satisfied if closely analyzed, will more than offset the increased cost of the oversized tire over the cost of the regular sized tire.

The Other Side of the Argument

The possible disadvantages of the oversized tire are its additional first cost and the possibility that if the tire is injured so badly as to be beyond repair, the net loss is greater on account of the relatively greater investment.

All things considered, however, we have no hesitation in urging our customers who are not getting satisfactory service out of regular sized tires to use the oversize; and as previously stated, no case has come to our attention of the return of such person to the regular sized tire.—DIAMOND RUBBER CO.

Decisions of the Courts—Must Sue Repair Man

By GEORGE F. KAISER

REPAIR man is responsible alone when a collision occurs after a car has been turned over to him for the purpose of being repaired and tuned up.

While an automobile was in the possession of a repair man for the purpose of being put in order and was being tested by him, it collided with a motorcycle. The motorcyclist was injured and brought suit against the owner of the car. The latter showed that he had bought the car for the purpose of speculation, intending to sell it again. It was an old car and it had been turned over to the keeper for a small garage who was to put it in order. He was to be paid for his services and, if he was able to sell it for more than the owner's asking price, he was to receive a commission in addition. The repair man worked on the car at odd times for a month and finally took the car out one Sunday to test it. This was without the knowledge of the owner, who had given him no instructions or suggestions regarding the testing of the car. At this time the collision resulted.

The Court said that when a man turned a car over to a mechanic for repairs and exercised no control over it nor over the mechanic, if the mechanic, finding that a test is necessary, tests the car and injures someone, the owner is no more responsible than if the mechanic took it without any authority and the injured party must seek recourse against the mechanic.—*Segler vs. Callister*, 139 *Pac.* 819.

$3,500 Judgment Affirmed

Connecticut Court says that, when a collision occurs between an automobile and a wagon, and the person riding on the wagon is injured, the owner of the car is responsible in money damages, if she allows another to act as her agent in giving the chauffeur instructions.

This collision resulted while the car was being driven by a chauffeur under the direction of the owner's 18-year-old daughter, who was taking two girl friends out for a drive. After going to a near by town, they returned home and the daughter directed the chauffeur to drive home to his own house for supper and to bring the car back again. The chauffeur went home, had supper and then, coming back, the collision resulted.

The Court said that the mother was not liable, merely because of the relationship of mother and daughter, but because she had given the daughter authority to direct the chauffeur and had told the latter that he was to take orders from the daughter in the absence of direct orders from herself and stated the rule of owner's liability to be that he is liable "for all acts done by a servant in obedience to the express orders or directions of the master, or in the execution of a master's business within the scope of his employment and for acts in any sense warranted by the expressed or implied authority conferred upon him, considering the nature of the services required, the instructions given and the circumstances under which the act is done; for acts which are not within these conditions the servant alone is responsible.—*Carrier vs. Donovan*, 89 *Atl.* (*Conn.*) 894.

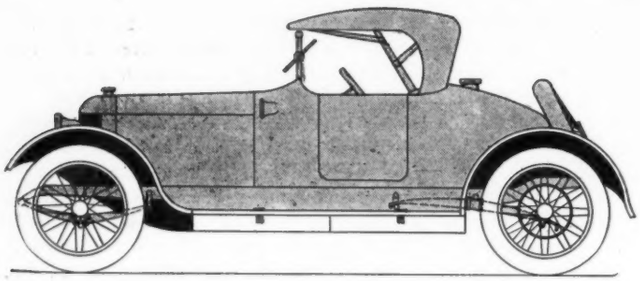
Judgment for Children

New Jersey Court holds that when a person is placed in a position of peril, as the result of another's negligence, if he makes a mistake of judgment in the moment he has to decide, he is not guilty of such negligence as will bar him from recovering judgment for injuries from the other negligent party.

A suit was started by the representatives of three adult children for their mother's death. The mother was killed while crossing Atlantic avenue in Atlantic City, being run down by an automobile which was going along at great speed.

No Time To Decide

The Court said that the judgment for the representatives of the deceased against the motorist was proper as, where a person in a moment and position of peril, which is the result of another person's automobile charging down upon the person at great speed, makes a hasty decision and does not do the thing which would probably have been done if more time were given for consideration, is not so at fault as to be prevented from recovering damages from the motorist, guilty of reckless driving.—*Wescoat vs. Decker*, 90 Atl. (New Jersey) 290.



The Rostrum

Puts Old Shoes Over New

EDITOR THE AUTOMOBILE:—I noticed a communication in your issue for September 10 from W. B. Duling, Back Bay, Wis., regarding the use of old tires over new ones, and I thought you might like to hear other readers' experiences with them. Using old discarded tires in this way has become a general practice in this section of the country. All, of course, do not use them, but a great many do to good advantage.

To use the old tires, Fig. 1, do not cut the head off. You have to take the casing off the wheel and insert, by hard work, into the old casing and apply both to the wheel at one time. Then you have practically a puncture-proof tire and one that is long lasting. It is desirable to have good inner tubes on account of it being too much trouble in changing in case an old tube gives away. So far as heat and sand are concerned, it does not seem to amount to anything. The old casing fits so tightly over the good one that there is no slippage and it protects the good tire from road heat. Some drivers, however, cut slits in old casings around the whole tread from bead to bead. They say it makes them easier to apply, as well as to allow ventilation. These slits are cut about every 4 inches and about 1-2 inch of the material taken out. I know a traveling salesman who covers a vast territory, is all the time on the road, and he used this equipment for over 2 years and never has had a puncture.

Coolidge, Texas. W. M. PRICHARD.

From Illinois to Texas

Editor THE AUTOMOBILE:—Please give through THE AUTOMOBILE the best route to San Antonio, Texas, going by way of Kansas City and Webb City, Mo.?

Winchester, Ill. WILSON COULT.

—First go to St. Louis, and then through Columbia and Marshall to Kansas City, 350 miles. Then turn southwest to Arkansas City, 232 miles, through Emporia and Florence. The next large city is Dallas, 417 miles, through Oklahoma City and Dennison. Turn west to Fort Worth, 33.2 miles and then go south to San Antonio, 354.4 miles, through Waco and Austin.

Wants to Use Car Motor in Boat

Editor THE AUTOMOBILE:—1—What would you consider the necessary changes in order to make a 30 horsepower White automobile engine give good service as a motor boat engine?

2—What kind of a propeller must be used?

3—Would it be advisable to lower the compression by putting a fibre gasket under the cylinders?

4—Would it help this engine any to change the valve timing, and if so, how could this be accomplished?

Montgomery, Ala. R. S. B.

—1—This motor should give satisfactory service without any changes. Proper cooling arrangements should be made, however. The flow of water through the cooling system should be regulated so that the temperature of the water issuing from the motor will be at a temperature of about 180 degrees Fahrenheit.

2—The type of propeller depends on so many things that it is impossible to say what kind or size to use. Write to the propeller manufacturers stating the size of the motor, its speed, the size of the boat, including length, beam and draft; the weight of the boat, and give a general idea of the lines of the hull.

All these matters have an effect on the size, shape and speed at which the propeller is to run. For instance, if the boat is so large that this motor cannot possibly run it more than 10 miles per hour, the propeller cannot be operated at as fast a speed efficiently, as if the maximum speed of the boat were 20 miles per hour.

3 and 4—No.

Formula Should Consider Stroke

Editor THE AUTOMOBILE:—I was very pleased to see that on page 407 of THE AUTOMOBILE for August 27, 1914, you recommended the horsepower formula $\frac{D^2 S N R}{15{,}000}$. For a number of years in the hospitable columns of THE AUTOMOBILE and *Motor Age* I have been advocating a similar formula having for its divisor 12,000. The results given by the $\frac{D^2 S N R}{12{,}000}$ formula which I devised in 1906 are somewhat higher than those obtained from the rating which you recommend, but are probably nearer the actual output of the fairly efficient motors of today.

As regards simplicity the $\frac{D^2 S N R}{12{,}000}$ rating scores even over the now discredited S. A. E. formula $\frac{D^2 N}{2.5}$. For example, if the power developed by a four-cylinder motor at 1,000 revolutions per minute is desired, the formula becomes merely $\frac{D^2 S}{3}$; for a six-cylinder motor under the same conditions, $\frac{D^2 S}{2}$; etc.

London, England. JOHN JAY IDE.

No Free-for-Alls in 1913

Editor THE AUTOMOBILE:—1—Could you tell me the name, date, place, distance, cash prizes, and who won in every free-for-all race held in the U. S. during 1913?

2—When and where will the American Grand Prize be held in 1915?

3—What are the rules governing a free-for-all race? Would a steam automobile, a motor cycle, or a tri-car be allowed to compete in one?

4—Why does THE AUTOMOBILE, editorially, favor races with a limited piston displacement?

Roebling, N. J. SIEGFRIED ROEBLING.

—1—According to THE AUTOMOBILE for this year no free-for-all events of importance were run. Possibly some small races of this type were run but the results of these are not obtainable.

2—The Grand Prize race will be held on March 7 at the Panama Pacific exposition, San Francisco, Cal. The race will be on the exposition grounds.

3—A steam automobile would be admitted, but a motorcycle, or a tri-car would not, unless it had a reverse gear. The rules state, "A Non-stock free-for-all race is open to any gasoline car which complies with the definition of motor car, without restriction as to piston displacement, price or quantity produced." And a motor car is defined as, "A vehicle of three or more wheels propelled by a self-contained mechanical means, fitted with at least two brakes, operated independently of each other and a motor-driven reversing mechanism.

4—We favor races with limited piston displacement because these contests force the maker to obtain greater efficiency and power from a motor of given size and this leads to improvements in stock car design. Furthermore, the racing motors of limited piston displacement are more nearly the size of stock car motors and the lessons learned in racing can often be directly applied to stock car practice. For instance, if it is found that a connecting-rod of a given size and shape stands up satisfactorily in a racing machine, the same rod might be used in a stock motor, where the greatly reduced strains would make it unlikely that one of these would ever break in service.

Remedy for Slipping Clutch

Editor THE AUTOMOBILE:—One of our customers, who owns a 1910 model Buick has had trouble with the clutch slipping and we write to ask if you could suggest anything to remedy this.

Williamsport, Pa. THE HARER-WURSTER CO.

—The slipping clutch may be due to a worn facing or weak spring—or in the case of the 1910 runabout which is equipped with a planetary gearset, the leather may be overlubricated due to grease leaking in through the worn transmission bushings. Remove the facing, clean it well and if it is made of leather soak it in neat's-foot oil for 24 hours before replacing.

To Locate a Loose Push Rod

Editor THE AUTOMOBILE:—What is the easiest way of locating a loose push rod?

Sugar Grove, Ill. H. V. SMITH.

—A loose push rod can easily be found by feeling with the hand. If there is too much clearance between the stem and the top of the rod, it can be ascertained by rattling the push rod and if this is the case, it should be adjusted, preferably while the motor is warm. Make the space about 1-100 inch or the thickness of a sheet of writing paper.

If the rod is worn in the guide, a certain amount of lateral movement will be noticed when force is applied to the rod by the hand.

Arched Manifold Reduces Loss

Editor THE AUTOMOBILE:—What is the reason for having the intake manifold arched as in the Mercedes cars used in the recent Grand Prix race in France, and in the Mercedes which De Palma drove at Indianapolis?

2—What kind of rings are used on the rotary valve of the Jaeger motor? Are they pinned? If so, are they fastened to valve or casing?

3—What is your opinion as to the reliability of the Van Kueren motor? Does this motor keep good compression at all times, and is there bearing enough between the ports and the port in the top of the cylinder to maintain compression after the motor has been used for a considerable time?

4—Is there any rule for determining the compression pressure for a certain size motor?

5—What should be the size of valve openings in a rotary valve for a motor 3¾ by 5, four-cylinders, compression 85 to 90 pounds, speed, 2,500 or 3,000 revolutions per minute, cone-shaped compression chamber?

6—What power should it develop?

7—What should be the timing of such a motor?

East Marion, L. I. W. FURST.

—1—Apparently the arch is to allow the carbureter to be carried high and at the same time provide a passageway without sharp curves.

2—This is unobtainable.

3—We have not seen this motor in service and therefore cannot say whether it retains its compression.

4—The compression pressure does not vary with the size of motor but is independent of it. The compression pressure depends on the ratio of clearance to piston displacement. If these two facts are known, the compression may be calculated, assuming that the rise in pressure follows the adiabatic law, that is, no heat is given to the charge or taken from it during compression. This is approximately correct.

$$\text{Compression press.} = \left(\frac{\text{clearance vol.} + \text{pist. disp.}}{\text{clearance volume}}\right)^{1.4} \times \text{atm. press.}$$

By compression pressure is meant the absolute pressure, which is equal to the gauge pressure plus 14.7 pounds. The volumes are expressed in cubic inches and the pressures in pounds per square inch.

5—There is very little data on this subject but we would advise making the valve ports with an area of at least 3 square inches, and larger if your motor design will allow.

6—The power should be 56 according to the formula,

$$\frac{D^2 N\ S\ R}{15{,}000}$$

, when the motor is running 3,000 per minute.

Where D=bore in inches, N=number of cylinders, S=stroke in inches and R=revolutions per minute.

7—Intake should open 20 degrees after top dead center and close 40 degrees after lower dead center. The exhaust valve should open 60 degrees before lower dead center and close 15 degrees after top dead center.

How to Adjust Hudson Axle

Editor THE AUTOMOBILE:—Will you please describe how to adjust the rear axle parts on the Hudson 37?

New York City. L. W.

—The adjustments on this axle, which is illustrated in Fig. 2, are as follows: The outer pinion shaft bearing is adjusted by means of the lock nut A, while the inner pinion

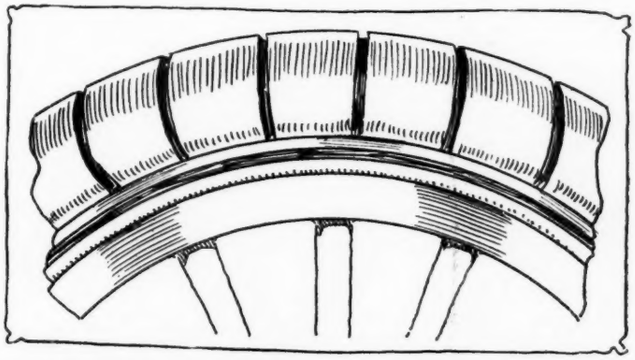


Fig. 1—One method of placing a worn out casing over a good one. In this case slits are cut in the outer casing at intervals of 4 inches to give a non-skid effect

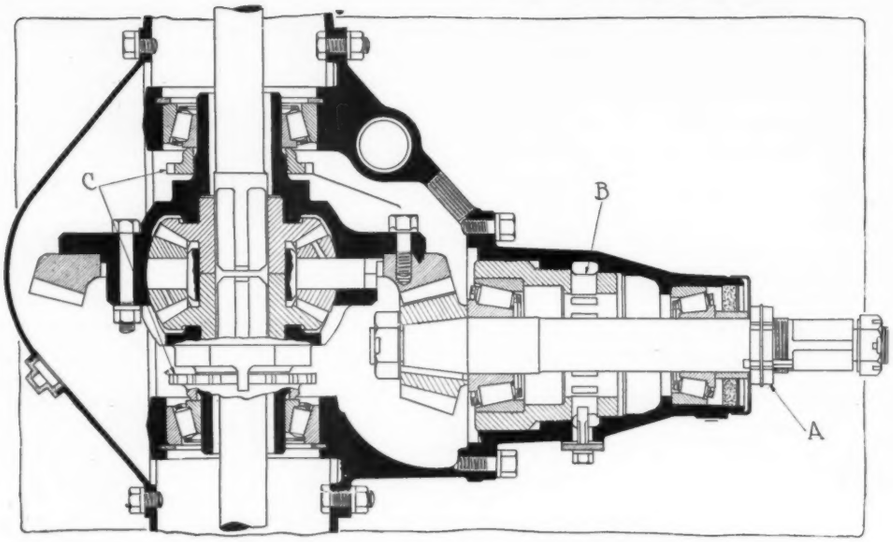


Fig. 2—Hudson model 37 axle showing points of adjustment

shaft bearing is held in a cage B which is capable of adjustment by screwing to the right or the left. It is positively locked by a set screw.

The differential bearings are adjusted by means of the nuts C.

The wear in the drive pinion may be taken up by means of the adjusting nuts A and B, the object being to set the pinion closer to the gear, in order to compensate for the wear. Play in the differential is removed by similarly adjusting the nuts C.

Comparison of Long and Short Strokes

Editor THE AUTOMOBILE:—1—A friend and I had a dispute over long and short stroke motors. Which motor develops the most power, one with an equal bore and stroke, or the one with the longer stroke than bore; both having the same displacement?

2—Which will give more power when driving over hills?

3—Which will give more speed.

4—Which will be more economical?

5—Can you supply an illustration in which a person will be lifting a weight with a two foot lever, and another with a ten foot lever, to these motors?

6—Would you place the person at the short end or the long end of the lever to bring out the point.

7—If I stand about 3 feet away from fender of car, and touch spark plug with a piece of metal when motor is running, I receive a shock. Can you explain how it makes a circuit through the pneumatic shoes?

Verona, N. J. THOS. P. LAMBE.

—1—Within reasonable limits there is very little difference between the two types as regards the power developed.

2 and 3—At equal motor speeds the power and maximum car speed would be the same.

4—Somewhat greater economy may be obtained from the long-stroke type.

5 and 6—The question of leverage does not enter into the problem at all. Let us consider a 4 by 4-inch motor and a 3.5 by 5.25 motor, the former having a displacement of 201.1 cubic inches and the latter 202. The former is square and the latter may be called a long-stroke motor. Under the same conditions, this includes temperature of combustion chamber walls, compression, and time of ignition, etc., almost the same pressure will be generated by the combustion of the charge. In both cases the expansion of the gases will be brought to about the same point before the exhaust valve is opened, and therefore the mean effective pressure in both instances will be practically the same. It can be assumed to be 90 pounds.

The work developed during the stroke is equal to the total average pressure on the piston during the stroke multiplied by the distance through which it moves. Therefore, power per stroke = area of piston $\times$ average pressure per square inch $\times$ length of stroke.

The area of the 4-inch cylinder is $4^2 \times .7854$, or 12.55 square inches, while the area of the 3.5 inch cylinder is 9.6 square inches.

Therefore the total amount of work done in each case is,

Work $= 12.55 \times 4 \times 90 = 4{,}500$ inch pounds.

Work $= 9.60 \times 5.25 \times 90 = 4{,}500$ inch pounds.

7—You experience a shock for the reason that the voltage is high enough to force a current through your body, the ground and up through the tire to the motor again, and thus the circuit is completed. The rubber is not a perfect insulator; probably because there is always a certain amount of moisture in it. The quantity is small but sufficient considering the great voltage.

Reasons for Motor Knocking

Editor THE AUTOMOBILE:—My Ford car knocks when running free. It has been overhauled twice. Has new block, crank shaft, pistons, camshaft and timing gears. In fact it has a new engine, added piece by piece. The knock is said by an expert Ford mechanic, to be in the crankshaft and camshaft gears. It does not knock when working hard. The position of the spark does not affect it, but a certain notch on the throttle lever brings it out strongly. What can you suggest?

Portland, Me. WALTER E. TOBIE.

—It is impossible to state where this knock is but it does not seem likely that it is in the timing gears. Possibly the cause is a loose bearing, due to wear or carelessness in assembling the motor. Examine the main connecting-rod, camshaft and wrist-pin bearings for this trouble. See that the compression is good in all the cylinders and that the valves are tight and seating properly.

Speeds of Various Cars

Editor THE AUTOMOBILE:—1—Kindly give me in the Rostrum the following information: The highest speed that can be made with each of the following cars, fully equipped with touring car bodies.

Packard, 38.

Peerless, 38.

Franklin, 30.

2—Also, kindly give gear ratios of each.

Matador, Texas. L. B. HUBBARD.

—1—The speeds of these cars are as follows: Packard, 67 miles per hour; Peerless, 60; and Franklin, 55.

2—The gear ratios are: Packard, 3.53 or 3.93, at option; Peerless, 3.56 to 1; Franklin, 3.69 to 1.

Brush Motor Will Run Generator

Editor THE AUTOMOBILE:—Please let me know what you think of this outfit. A Brush engine from a Brush car to run a 3 K.W. generator direct connected to a 110-volt dynamo.

Please let me know if this engine will run it direct connected satisfactorily and without any flickering.

Eunice, La. K. MOOSA.

—If you operate your generator at full capacity at any time and the speed of the generator is in the neighborhood of 1,500, the motor will hardly develop enough power to allow of it being direct connected.

It is a simple matter, however, to do it by means of a belt. Your motor will run this generator satisfactorily, providing the belt pulleys are the proper size and a good governor is fitted. The flickering of the lights depends entirely on how smoothly your motor runs under varying load conditions and this in turn is affected by the sensitiveness of the governor and the size of the flywheel.

You have not given enough details for us to determine the size of the pulleys or advise you as to the other details of the installation. Probably your generator runs at a speed of about 1,500 revolutions per minute. The motor should be run at such speed that an overload of 50 per cent. or a 3 K. W. can be carried. This is approximately 4 horsepower.

Since the bore and stroke are 4 by 5 inches, the motor will produce this horsepower at 750 revolutions, according to the formula:

$$\text{Horsepower} = \frac{D\,S\,N\,R}{15{,}000}$$

or

$$R = \text{revolutions per minute} = \frac{\text{horsepower} \times 15{,}000}{D\,S\,N}$$

Where D = bore in inches
S = stroke in inches
N = number of cylinders, which is 1

Substituting, we have,

$$\text{revolutions per minute} = \frac{4 \times 15{,}000}{4^2 \times 5 \times 1} = 750$$

It must, of course, be borne in mind that the solution given by this formula is not absolutely accurate, but it should be near enough. The only sure way to determine the speed at which this motor must run to develop 4 horsepower, would be to test it.

Therefore, if your generator runs at 1,500 revolutions per minute, the pulleys for driving will need to be in the ratio of 2 to 1. If the speed of the generator is some other amount the ratio can easily be calculated.

The flywheel on this motor is approximately 17 inches in diameter and 2.5 inches wide, therefore, the pulley on the generator should be about 8.5 inches in diameter and 2.5 inches wide.

The thickness of belt can be determined by the formula taken from Machinery's Handbook:

$$\text{Horsepower} = \frac{P\,W\,D\,N}{12{,}000}$$

P = number of plies in the belt; 1, 2 or 3.
W = width of belt in inches
D = diameter of smaller pulley in inches
N = revolutions per minute of the smaller pulley

The number of plies represented by P is just another name for the thickness. The width of belt D is limited to 2.5 inches, and had better be made 2 inches. D, the diameter of the smaller pulley, is 7.5 inches, and its speed per minute, N, is 1,500.

Solving the above formula for P, we have

$$P = \frac{12{,}000 \times 4}{2 \times 7.5 \times 1{,}500} = 2.15,$$ which can be taken as 2,

in other words a 2-ply belt should be used.

A governor may be obtained from the Pierce Speed Controller Co., Anderson, Ind., or the Duplex Engine-Governor Co., 80 Maiden Lane, New York City.

Both engine and generator should be solidly mounted. A large tank of water would be satisfactory for cooling, the thermo-syphon system being used. The outfit may be mounted on a steel or wood frame, or may be fastened to a stone, brick or concrete foundation.

Starter Gears Noisy

Editor THE AUTOMOBILE:—I have an electric starter on my car and several times lately when I put my foot on the button to start the car, it makes a noise as though every gear in the car was being stripped. Can you tell me the cause for this, and how to remedy same?

Lowville, N. Y. L. H. SMITH.

—It is possible that the gear teeth are worn or that the armature bearings allow play. Inspection should show whether this is so. It may be that the gears need oiling. It must not be forgotten that a starter should make a little noise, the amount depending on the design, workmanship and material.

Valve Diameters of Large Cars

Editor THE AUTOMOBILE:—What are the outside diameters of the valves in the following cars:

1—Pierce-Arrow 38-C3, 48-B3, and 66-A3; Packard 38 and 48; Peerless 38, 48 and 60; and Chalmers "Master" and "Light" sixes for 1915?

St. Louis, Mo. E. H. K.

—1—The outside diameters of the valves on these cars are as follows:

Pierce-Arrow,	38	C-3, 2 3/16 inches.
Pierce-Arrow,	48	B-3, 2⅜ inches.
Pierce-Arrow,	66	A-3, 2¾ inches.
Peerless,	38	Discontinued.
Peerless,	48	2 17/64 inches.
Peerless,	60	Discontinued.
Chalmers,	29	2.182 to 2.192 inches.
Chalmers,	29B	1.932 to 1.942 inches.

Make of Engine in Selden

Editor THE AUTOMOBILE:—What is the make of engine used by the Selden Motor Vehicle Co., in its five-passenger touring car, Model 40-T?

Alexandria, Louisiana. J. R. STANLEY.

—According to the information we have at hand the motor is either a Brownell, Continental or a Buffalo. We would advise you to write the Selden Motor Vehicle Co., Rochester, N. Y., stating the motor and car number, for more definite information.

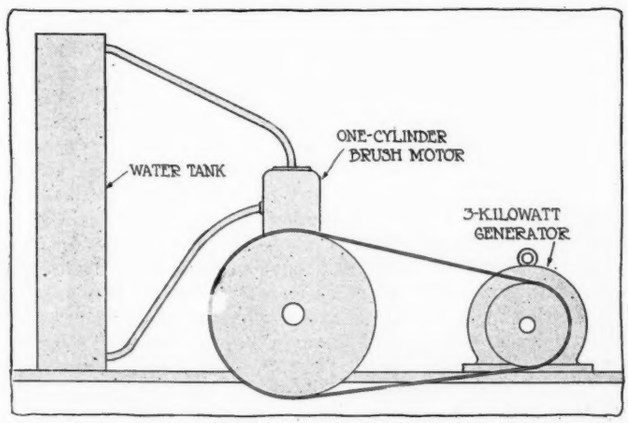


Fig. 3—Diagram showing layout for connecting Brush runabout motor to a 3 K.W. generator for stationary lighting work

The Engineering Digest

The Design of Valve Control Organs—Formulas Developed for Springs, Cams and Camshafts

A METHOD FOR DESIGNING CAMS IN UNISON WITH SPRING TENSIONS AND MOTOR SPEED

THE NEEDED RIGIDITY OF CAMSHAFTS

(*Continued from issue of September* 10)

FORMS and Dimensions of cams are determined by the folowing factors: (1) Valve lift, (2) nature of the tappet action—roller, flat or cambered plate or hammer type, (3) timing of opening and closing of valves, (4) the curve representing the piston travel, (5) the curve representing the valve travel under the kinematic influence of the valve spring, and (6) the play between tappet and valve stem.

The valve lift can be determined from equation 4 [see the previous instalment]. The nature of the tappet action (2) and the valve timing (3) must be chosen suitably. The form of the tappet head or roller determines the cam profile if the curve of valve travel is known. For the valve timing no definite rule can be established, as practice varies surprisingly. In 18 leading models of French automobile motors of 1912 the timing varies as follows (according to Henri Petit: Le Moteur, 1912 edition): The advance of exhaust valve opening from 30 degrees in Vinot-Déguingand and 32 degrees in Renault to 58 degrees in Ariès and Sultan; the retarding of exhaust valve closing from 0 degree in 9 of the 18 models to 15 degrees in the Peugeot; the retarding of the inlet valve opening from 0 degree in 4 models—including Panhard and Darracq—to 23.5 degrees in Renault; the retarding of the closing of the inlet valve from 5 degrees in Grégoire to 58 degrees in Peugeot, with the majority between 30 and 45 degrees.

These figures are all to be understood as relating to degrees upon the crankshaft circle.

In other works (Faroux: Construction Automobile, 1913 edition, and Lacoin: Construction et Réglage des Moteurs à Explosions, 5th edition) the average timing used by large French firms for an average motor speed of 1,370 revolutions per minute is given as 46, 5, 12 and 25 degrees for the four valve movements in question.

The large variations in the timing are no doubt partly due to undersized valves and too complicated forms of inlet and exhaust conduits, which interfere with the filling and emptying of cylinders within the regular periods of the cycle at high motor speeds and render it necessary to extend the periods for suction as well as those for exhaust by artificial means. The widely accepted opinion that the first and the fourth cylinders should have a different valve-timing from that of the second and the third must be explained likewise, as no other rational explanation presents itself. The only thing which can be stated in general, on the basis of practical experience, with regard to valve-timing, is that it must vary with the motor speed [meaning the normal motor speed], with the specific gas velocity in the conduits and with the volumetric compression. Theoretically next to nothing may be said, but for small high-speed motors practice sanctions the figures of 50, 4, 8 and 40 degrees for the advance of exhaust opening (α_1), the retarding of exhaust closing (β_1), the retarding of intake opening (α_2) and the retarding of intake closing (β_2), respectively.

In laying out separate cam diagrams it is important to determine the positions of both cams with accuracy. As the camshaft runs only half as fast as the crankshaft, the angles of advancing and retarding must be marked half as large on the cam diagram as the corresponding angles (α_1, β_1, α_2 and β_2) on the valve-timing diagram relating to the crankshaft. In accordance herewith the angle α_o spanned by the base of the exhaust cam and determining the period from opening to closing of the valve is

$$\alpha_o = 90° + \frac{\alpha_1 + \beta_1}{2} \qquad (8)$$

and for the intake valve

$$\beta_o = 90° - \frac{\alpha_2 - \beta_2}{2}, \qquad (9)$$

α_o and β_o being center angles of the camshaft circle. The lines dividing angles α_o and β_o in halves may be designated as cam axes; then the angle γ between the two cam axes is

$$\gamma = \tfrac{1}{2}\left(90° + \frac{\alpha_1 + \beta_1}{2} + 90° - \frac{\alpha_2 - \beta_2}{2}\right) + \frac{\alpha_2 - \beta_2}{2} = 90°$$

$$+ \frac{\alpha_1 + \beta_1 + \beta_2 - 2\beta_1 + 2\alpha_2 - \alpha_2}{4} = 90° + \frac{\alpha_1 + \alpha_2 - \beta_1 + \beta_2}{4} \qquad (10)$$

With these data a diagram is laid out, as in Fig. 3, on which the dead centers corresponding to two revolutions of the crankshaft—set 90 degrees apart, as a graphical expedient, to allow for the difference in crankshaft and camshaft movements—the cam axes and the four valve-opening and valve-closing points are marked on a circle. The diameter D of the circle is best taken as

$$D = 2\,(d' + 2m) \qquad (11)$$

as that gives a diagram on the scale of 2 to 1 or twice life size.

Notations

The angles α_1, β_1, α_2, β_2, α_o, β_o as explained in text.
d' = diameter of the base circle of the cams.
m = play between tappet and valve stem.
l = valve lift.
D = diameter of base circle of cams on 2 : 1 diagram.
D_1 = diameter of top circle of cams on 2 : 1 diagram.
d'' = diameter of roller.

With l the valve lift, the diameter of the top circle of the cams becomes

$$D = 2\,(d' + 2m + 2l) \qquad (12)$$

The base circle of the cams is to be chosen as large as the construction permits.

The above applies to the case when it is intended to use plate or hammer tappets. If rollers are to be used, D and D_1 must be enlarged with twice the diameter d'' of the roller, and then

$$D = 2\,(d' + d'' + 2m) \qquad (11A)$$

and

$$D_1 = 2\,(d' + d'' + 2m + 2l) \qquad (12A)$$

[It is noticed that the author is occupied only with stand-

ard construction and assumes, for example, that the valve lift of the intake valve should be the same as that of the exhaust valve, although much has been said lately of the advantage in making the lift of the intake valve greater rather than keeping the valve open for 40 degrees after dead center.—ED.]

When the diagram has been laid out up to this point, the piston travel curve is drawn into it for each cam, starting from the dead centers. If the gas velocity in the valve port were naturally constant, this curve would represent the valve travel, too. But in reality this is not the condition, and the piston travel curve represents only the minimum of the valve lift for each corresponding position of the piston. To prevent the gas velocity from assuming a higher value at any point of the piston travel than that provided for in the dimensions of the conduits, the lift of the valve at any point must be higher than shown by the curve of piston travel; compare the two pairs of curves in Fig. 3.

To construct the piston travel curve, the angles on the crankshaft circle corresponding to, for example, 10 equal divisions of the piston travel are first determined graphically, as in Fig. 2, the method being obvious. This figure is here shown on a reduced scale. The halves of these angles are transferred to the camshaft diagram, Fig. 3, so as to obtain a division of two 90 degree arcs of the cam circle in 10 unequal parts, corresponding to the 10 equal parts of the piston travel.

On the polar [radially converging] ordinates obtained in this manner, the corresponding lengths of l, enlarged to the 2 : 1 scale, are marked off, starting from circle D. These lengths can be figured from the equation

$$l = \frac{d^2 \cdot s \cdot n}{d_2 \cdot 6{,}000} \times \sin \alpha \ (1 \pm k \cos \alpha)$$

[this being a standard equation for a valve lift giving uniform gas velocity, approximately; compare "Hütte," 20th edition, volume II, page 307, or modern gasoline engine textbooks.—ED.]

Notations

d = cylinder bore in cm.
d_2 = diameter of valve.
s = piston stroke in cm.
n = revolutions per minute of crankshaft.
α = center angle of crank.
k = crank length divided by connecting-rod length.
$Z = \sin \alpha \ (1 \pm k \cos \alpha)$.

The first member of the value for l, being a constant can be figured out readily. The second member, a variable in which α is the angle turned by the crank, at any given point in the movement, and k the ratio of crank length to connecting-rod length, may be designated as Z. The values for Z are calculated and tabulated herewith for a value of $k = 1/5$ and for 10 equal divisions of the piston stroke (compare Güldner: Entwerfen und Berechnen von Verbrennungsmotoren, 2nd edition, page 317).

Percentage of Piston Stroke.....	10	20	30	40	50	60	70	80	90	100
Values of Z.....	0.648	0.853	0.962	1.011	1.014	0.976	0.892	0.759	0.554	0

The values for l_1, l_2, l_3, etc., are now in the form of $l = AZ$, in which

$$A = \frac{d^2 \cdot s \cdot n}{d_2 \cdot 6{,}000} \qquad (13)$$

and the values for Z are taken from the table above.

The curve of the valve travel and of the corresponding time periods during the closing movement of the valve determines the releasing-profile of the cam. Between the curve of the valve release and the parabola described by the valve under the influence of the valve spring [the vertical valve movement becoming a parabola when viewed in its relation to the rotating circumference of a cam or camshaft.—ED.], there must be a certain relation, in order to avoid noisy bounding of the tappet on the cam or of the valve stem on the tappet, accompanied by too late closing of the valve.

The release-curve must therefore coincide with one representing the free (spring-determined) movement of the valve during the closing period. A relation between the trajectory and the velocities of the movement must therefore be provided. Fig. 1 indicates the method to be followed [and illustrates also the manner of obtaining equations 5, 6 and 7, relating to the dimensions of valve springs, in the previous instalment], the movement in question being conceived as part of a rectilinear oscillation of which the full course ac is equal to twice the deflection of the valve spring at fully open valve, so that $ac = 2f_3$.

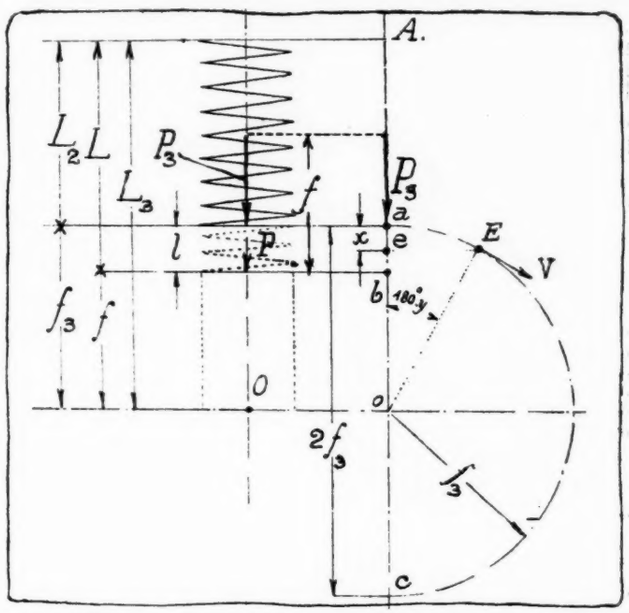


Fig. 1—Diagram of spring tensions, auxiliary in determining valve-releasing curve

It is assumed, as may be done without notable error, that the spring tensions are proportionate to the deflections. Aa represents the length of the spring at its initial tension; that is, with valve fully open, as at the beginning of the closing; and Ao the total length of the released spring (equal to L_3 by previous notation), so that the force of the spring steadily diminishes from a to o, dropping from P_3 at a to zero at o. Also, we have $P_3 : f_3 = P : f$.

Under such conditions the oscillation can be considered as the projection—speaking with reference to the graphic representation of it—of a uniform circular movement which the valve body describes under the influence of a radial force P_3 and a constant tangential velocity V.

If the mass of the valve body is M and t_o is the period of oscillation; that is, the time in which the body, moving at uniform velocity along the circle, reaches from a to c, then

$$t_o = \pi \sqrt{\frac{M \cdot f_s}{P_s}}$$

If we consider an arbitrarily chosen point e between a and b, which is the projection of point E on the circle, and if we designate the length of ae as x and the angle aoE as $180° \cdot y$, then the time in which the body covers the distance ae, or the arc aE of the circle, is $t = t_o \cdot y$, or, inserting the value of t_o,

$$t = y \cdot \pi \sqrt{\frac{M \cdot f_s}{P_s}}$$

Consequently
$$y = \frac{t}{\pi} \sqrt{\frac{P_s}{M \cdot f_s}} \qquad (14)$$

On the other hand we have the relation (see Fig. 1)

$$x = f_s [1 - \cos (y \cdot 180°)]$$

By insertion of the value for y from equation 14, this gives

$$x = f_s (1 - \cos) \frac{180°}{\pi} \cdot t \sqrt{\frac{P_s}{M \cdot f_s}} \qquad (15)$$

By substituting for M its approximate equivalent .1Q, [under the metric system which has 9.81 m/sec for the factor of acceleration], where Q is the weight of the valve body, including spring plate and spline, we obtain (for f_s expressed in cm)

$$x = f_s \left[1 - \cos (57.29578° \times 31.623 \sqrt{\frac{P_s}{f_s \cdot Q}} \cdot t) \right] \qquad (16)$$

By designating as C the constant in the expression for the angle $y \cdot 180°$, we have first

$$C = 1811.1 \times \sqrt{\frac{P_s}{f_s \cdot Q}} \qquad (17)$$

and, by making use of this designation, equation 16 takes the simpler form

$$x = f_s [1 - \cos (C \cdot t)°] \qquad (18)$$

In order to draw this curve [meaning the curve determined by the values of x for a suitable number of locations of e] into the diagram, Fig. 3, it is necessary to determine the point at which closing begins, for both cams. With a view to the silence of the motor it would be desirable to place this point as close to the axis of the cam as possible and to shape the release curve gently declining. The piston travel curve admits however in only slight degree of such design, and the beginning of the closing period must usually lie 30 to 35 degrees from the point of valve closure, if the risk shall be avoided of raising the gas velocity toward the end of the exhaust stroke, thereby causing imperfect scavenging and poor subsequent filling of cylinders.

The values for x must be laid out radially from the top curve D_1 toward the center, while the corresponding values for t are represented by a radial division of the circle. This division is regulated by the following considerations:

If n is the number of crankshaft revolutions per minute, the camshaft makes $n : 120$ turns per second. Accordingly, the time in which the camshaft turns 2 degrees can be expressed as

$$T = \frac{2}{3n} \text{second}, \qquad (19)$$

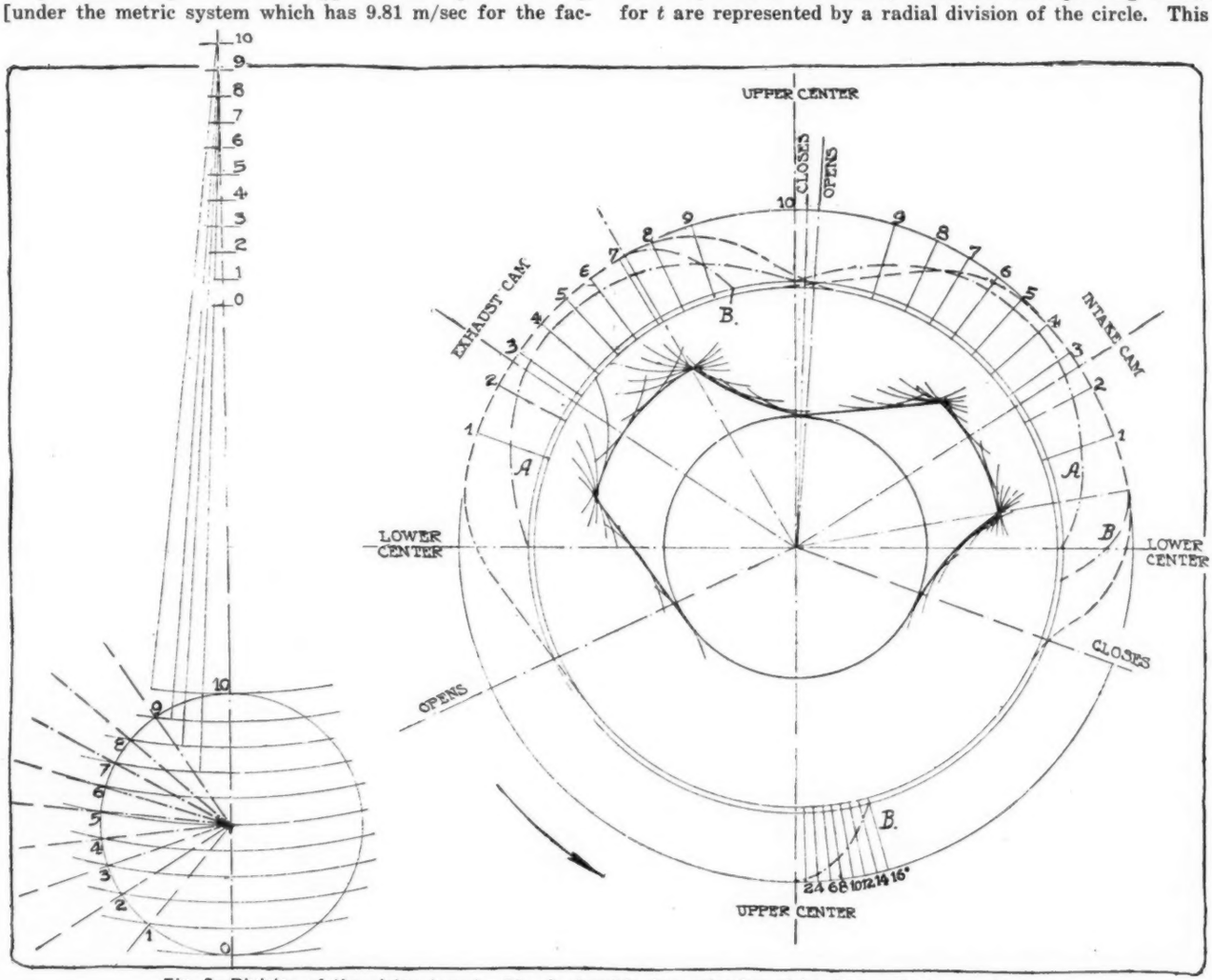


Fig. 2—Division of the piston travel. Fig. 3—Graphic determination of location and shapes of cams

and if arcs of 2 degrees are chosen for abscissas in the system of polar co-ordinates, the values for t obtained are

$$t_o = 0;\ t_1 = \frac{2}{3n};\ t_2 = \frac{4}{3n};\ t_3 = \frac{6}{3n};\ \text{etc.}$$

The corresponding values for x can then be calculated from equation 18.

Compromise in the Shapes

After the curve for each cam has been determined and laid out in the manner explained, the curve of the real valve travel can be found. The main condition for realizing a correct and practicable design is here that this curve lies outside of the curves so far determined, in each case. With the use of plate or hammer tappets it is necessary to make the raising and the releasing camside profiles symmetrical, as they must develop themselves tangentially upon the plate surface at the lifting as well as at the seating of the valve and therefore must be made rather strongly convex, tangentially to the base circle of the cam. If the camside is made rectilinear and tangential to the base circle and the tappet plate is flat, a blow is delivered against the plate at every lifting of the valve, and this is not admissible in view of the requirements for silence and durability. On the other hand, the curve of the camside must not be too convex, as then it collides with the curve of the piston travel. In most cases it is preferable to form the camside tangential to its base circle and convex at the junction with the piston travel curve, while giving the curvature at the cam base a smaller radius than at the cam top. Even with symmetrical shaping of the camsides the cams become rather pointed if the lines are made notably convex, and it is therefore in most cases not practicable to shape the releasing-profile with further special reference to an easy and slow closing of the valve. This is especially true for intake valves, as they span a smaller angle than the exhaust valves.

The inner end of the curve [by which the play in the tappet elements is taken up] is joined, between the circles D and d_1, as flatly tangential to the latter as possible.

If rollers are to be used or hammer tappets with heads of semi-circular profile, it is advantageous to shape the lifting camside rectilinear or even concave, in order to cause rapid opening of the valve, while the releasing-curve should be formed so as to retard the valve movement at the closing. The most approved method is to draw the lifting-curve as a rectilinear tangent to a circle of the diameter $D - 2m$ and to make it join the top circle D_1 with a rounding of radius $.5d''$ [d'' being the diameter of the roller, as before], while the releasing-profile is made as strongly concave as circumstances permit and, at the beginning of the valve-closing period, is joined tangentially to the kinematic valve-closing curve [being that marked B in Fig. 3 and determined by the valve spring tension] and continued concavely to the circle of diameter $D - 2m$.

The curve so obtained represents the movement of the center of the tappet roller and thus of the valve itself. To obtain the actual shape of the cam, arcs are described from points in this curve, as centers, with a radius of $.5d''$, and the cam shape is then drawn as the curve following these arcs tangentially, as indicated in Fig. 3.

For this illustration a motor with 80 millimeter bore and 120 millimeter stroke was chosen. The piston travel curves are marked A and the kinematic releasing-curves of the valves are marked B. To avoid confusion, B is constructed separately at the bottom part of the drawing and is afterwards transferred to its right places. The diagram is drawn to 2 : 1 scale [slightly changed in the reproduction] and intended for tappets with rollers. The curves for the travel of the roller centers are drawn in dashes, the final cam shape in full lines and the auxiliary curves, both A and B, in dots and dashes.

The lifting-curve of the intake cam intersects the piston travel curve at the beginning of the suction stroke in Fig. 3, and this relation would indicate increased gas velocity at this point. It is the unavoidable consequence of the retarding of the intake valve opening; but, far from being a drawback, the increased gas velocity at the beginning of the suction is greatly desired with a view to obtaining a uniform vaporization. The volumetric efficiency of the motor does not suffer; if for no other reason then because any loss of charge at the beginning of the suction is more than offset by a considerable retarding of the valve closure.

Required Rigidity of Camshaft

In motors with cylinders close together and short crankshafts running in only two bearings, the camshaft can also be mounted in two bearings, but must then be of very liberal diameter to avoid deflections and vibrations. An ordinary calculation of strength is insufficient, and it is necessary to ascertain the maximum deflection to which the shaft can be subjected. Even for shafts running in three bearings this calculation of the deflection is urgently advised.

The force to be considered is the resistance of the exhaust valve against lifting, and this is composed of the pressure of the expanding gases against the valve and the spring tension P.

Notations

- v = the gas volume at end of working stroke = cylinder volume.
- v_o = gas volume at beginning of working stroke = volume of compression chamber.
- v' = gas volume at moment of opening of exhaust valve.
- p_o = pressure at moment of explosion.
- p_1 = pressure at moment of opening of exhaust valve.
- p_2 = pressure at beginning of working stroke.

We have, through the relations of pressures to volumes,

$$p_1 = \frac{p_2 \cdot v_o}{v'}$$

For an advance release of 50 degrees the value for v' can be taken as approximately $v' = 0.85\,v$, considering the proportions between angle of turn and piston travel, and therefore

$$p_1 = p_2 \frac{v_o}{v} \times 1.175$$

As referred to before, e being the volumetric factor of compression,

$$\frac{v_o}{v} = \frac{1}{e} \quad \text{and hence} \quad p_1 = p_2 \frac{1}{e} \times 1.175 \qquad (20)$$

In practice this value for p_1 must be multiplied with the thermic efficiency co-efficient 0.75; which gives

$$p_1 = p_2 \frac{1}{e} \times 0.88 \qquad (21)$$

According to earlier research [referring to a development by the same author of a power formula for automobile motors without the aid of an assumed value for the mean effective piston pressure, published in *Der Motorwagen* for May 10, 1914]

$$p_2 = e\kappa + \frac{H\,(e-1)}{T_o\,Cvm\,(L+1)}$$

where κ (kappa) is the ratio between the specific heats of the explosive mixture at unvarying pressure and at unvarying volume, H the heat units of 1 kg. of gasoline, T_o the absolute temperature at the beginning of the compression stroke, Cvm the mean specific heat of the gas mixture at constant volume and L the weight of the air required for the combustion of 1 kg. of gasoline.

From this equation, by insertion of the assumed values, there is obtained:

$$p_2 = e^{1.3} + 7\,(e-1),$$

and thus we get from equation 21:

$$p_1 = \left(e^{0.3} + 7\,\frac{e-1}{e}\right) \times 0.88 = 0.88 \times e^{0.3} + 6.2\,\frac{e-1}{e} \quad (22)$$

[The author's reference to a formula developed on a previous occasion is here reproduced literally, but it seems necessary to state that an examination of this reference discloses several discrepancies between the notations used there and those employed in the present text, to the effect that only a lengthy and searching analysis could determine whether, despite these discrepancies, the author is justified in inserting the value for p_2, as taken from his development of a power formula, in equation 21 of the present text. If he is not so justified, the whole subsequent development of numerical values for the pressures acting to deflect a camshaft is of course vitiated, but is presented here on account of the interest of his method, while those sufficiently interested in ascertaining the true formula for p_1—to take the place of equation 22 which is in doubt—may look up the original articles or develop a formula for p_1 by independent means.

At any rate, the table of values given below should be accepted only with reservation.—ED.]

The discrepancies referred to are the following (with allowance for certain changes from both originals made for typographical reasons):

Notations employed	*In present text*	*In the reference*
Gas volume equal to cylinder volume =	v	v_0
Gas volume equal to compression space =	v_0	v'
Gas volume at opening of exhaust valve =	v'	not used
Pressure at moment of explosion =	p_0	p_2
Pressure at opening of exhaust valve =	p_1	not used
Pressure just before explosion-compression =	p_2	p_1
Pressure at beginning of compression stroke =	not used	$p_0 = 1$

The following table gives the values for p_1 calculated from equation 22 in kilograms per square centimeter for 50 degrees advance release of the exhaust and for compressions ranging from $e = 4$ to $e = 5$.

e =	4	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5
Pressure p_1 at moment of opening of exhaust valve	5.98	6.02	6.08	6.12	6.16	6.20	6.24	6.28	6.32	6.35	6.39

To obtain p_1 for another advance of the exhaust, the value given in the table may be multiplied with $0.85 : x$, in which x stands for $v' : v$ for the desired advance.

The force K necessary for raising the exhaust valve is accordingly, d_2 being the diameter of the valve:

$$K = P + \frac{\pi\, d_2^2}{4} \cdot p_1 \quad (23)$$

The importance of this calculation should not be underrated, as K can take considerable values. For example, even for a small bore of 80 mm, the value of K is found to be 87.8 kg.; and this value grows at the square of the bore.

The camshaft should have a diameter giving so high a resistance that the maximum deflection at the locations of the cams does not exceed 0.02 cm.

In Fig. 4, let a and b be the distances of the exhaust cam axis to the center lines of the bearings A and B and δ (delta) the diameter of the shaft.

We have then (see handbooks on beam stresses):

$$f = \frac{64\,K}{2\pi\,\delta^4 \cdot E} \cdot \frac{a^2 \cdot b^2}{a+b}$$

and, for $f = 0.02$ cm and $E = 2{,}200{,}000$ kg.:

$$\delta = 0.111 \sqrt[4]{\frac{K \cdot a^2 \cdot b^2}{a+b}} \quad (24)$$

—From article by A. G. von Loewe in *Der Motorwagen*, July 10.

Construction Lessons from Grand Prize and Tourist Trophy Races

ONCE let loose, so to speak, upon a stem to stern design for racing and racing alone, almost every engineer turned to the overhead valve engine quite naturally, says *Automobile Engineer* editorially in commenting upon the inferences which engineers and the employers of engineers are now in a position to draw from the results of the English Tourist Trophy race and the French Grand Prize race of this year. Some of the remarks of the commentator have a bearing upon normal as well as racing construction and are reproduced in substance—with some additional comment—as follows:

The premier race of the year has been won by a type of engine quite new to the road, and the Minervas in the Tourist Trophy event have shown that the theoretical virtues of a hemispherical combustion chamber may be exploited by other means than the use of multiple poppet valves. The Mercedes and the Minervas were of equal originality of design, though in both of them the same theories were applied which underlie the Peugeot construction.

Did the Better Cooling Win?

There is no doubt that the Mercedes had more power than the Peugeots. In both types the top gear was direct, and that of the Mercedes was a good deal the lower. This means that the Mercedes drivers were not afraid of driving their engines at a decidedly higher speed than that at which the Peugeots were turning. Hence it is easy to see where the higher power came from. This leads to the all-important question: Why could the Mercedes engines stand the higher speed?

[In the absence of any evidence of overheating of Peugeot motors, the urgency of this question is perhaps not so conclusive as it might seem at first glance. It is possible that it was inferior road qualities of the Peugeot cars which prevented the vehicle speed, and therefore the motor speed, from being pushed to the limit, and that the reasons for the slight superiority of the Mercedes cars should be sought in

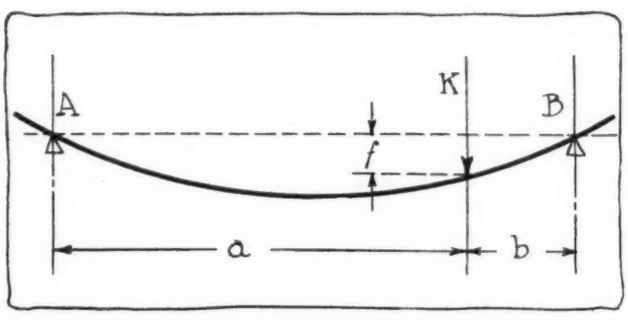


Fig. 4—Diagram of elements in rigidity of camshafts

their general vehicle design and in their spring suspensions, which determine how fast the driver dares to go—more directly than any anticipated motor troubles.—ED.]

It is the experience of most engineers that engines which can be run at four thousand revolutions per minute for an hour cannot be kept turning at that speed for five or six hours, although they may be able to run at three thousand revolutions for an almost indefinite period. On the face of it, there seems some difficulty in explaining this, because it is not clear what happens when running fast that takes an hour or more to develop. Fatigue of the materials is sometimes the reason; but what is wanted is an explanation as to why an hour at four thousand revolutions, say, should be more likely to produce fatigue than a week at three thousand. In not a few cases failures in engines which are being run at their maximum are traceable to overheating of one part or another—local overheating in fact—and this despite the utmost precautions to prevent the temperature of the water from rising unduly. It may be that in a highly stressed water-cooled engine heat is accumulated slightly faster than it can be dissipated, and that it is this slow accumulation which eventually takes effect—sooner or later, according to the design details of the engine.

Now recall the fact that the Mercedes steel cylinders are machined all over, inside and outside, that the jackets are welded on afterwards, so that the water spaces are all alike and there is an equally free flow of water around each combustion head and valve seat. Add to this that the walls are thinner than they must be if of cast-iron, and it becomes obvious that the cooling of the Mercedes engine is more certain, and probably more efficient as well, than the cooling of any cast-iron block-cylindered motor ever could be.

The Oil—Another Cumulative Factor

[In seeking for a factor which undergoes certain changes by the mere lapse of time, apparently, it would perhaps be well to consider the lubricating oil. In aviation motors of the Mercedes type and in nearly all racing motors a portion of the oil used is returned to the oil circulation system and is used over again. Now it is known that oil when exposed for some length of time to heat undergoes certain chemical changes of a rather subtle nature and largely depending upon exact temperatures and time periods. The polymerization of turpentine into isoprene and of isoprene into synthetic rubber is perhaps the best known example of this action. The oils are "cracked" more or less and lose volatile elements whose vaporization in the motor cylinders naturally contributes to the cooling-properties of the oil so long as it is fresh. It is thus conceivable that after some length of time at maximum temperature of the motor that portion of the lubricant which is derived from the circulation system loses both in lubricating and in cooling qualities, eventually lowering the efficiency of the motor for continued running—unless an entirely new oil supply is provided.—ED.]

Bevel Gear and Single Camshaft

As to the operation of poppet valves—with the now almost universal four-valve design, so far as racing motors are concerned—the Mercedes success has shown beyond all possible doubt that there is no need for the Peugeot train of spurgears to drive an overhead camshaft. On the contrary, it shows that a properly proportioned bevel gear of much smaller weight is just as efficient.

It has been said that in a high-stressed engine valve rockers are a source of weakness; this opinion accounting for the direct operation of the valves by Peugeot and Sunbeam from a pair of camshafts. As the single camshaft is constructively much preferable, it is good to know that the bevel-gear construction need not be feared any longer.

Another point brought out by the Mercedes is that plain bearings are good enough for a racing crankshaft if the oil pressure is high enough. Undoubtedly the rigidity of a good plain bearing gives much better resistance to the bending stresses of a shaft than ball bearings, though but few cases of actual failure of the latter have been reported.

A Question of Bearings

[At this point continental technical opinion leans toward the idea that plain bearings for crankshafts will eventually be worn out conically from the effects of irresistible vibrations, unless the dimensions are made larger than admissible from other points of view, and that, on the other hand, ball bearings can be protected against vibrations if they are either mounted so as to permit them to oscillate in response to the shaft vibrations or so designed that the balls can oscillate in the fixed outer ball race. This view thus favors ball bearings in the matter of durability and for ordinary cars—their adaptedness for block cast motors and short crankshafts being also considered—while for a racing motor the plain bearings may offer superior guarantees for any single exploitation of its stamina.—ED.]

Cantilever Springs in the Balance

It is to be regretted that the Vauxhall and the Aquila-Italiana in the two races were never able to show the behavior of their cantilever rear suspensions. If this type of spring is satisfactory for the ultimate test of the road race, it should be better than the half-elliptic, because it is easy to adapt to give a large amplitude of spring movement, and it has several advantages from the points of view of the erecting shop and the body builder. It must be left for next year to show how it can behave when called upon.

The outstanding lesson of the two big races is really that there is still plenty of opportunity for originality of design; that those who had the courage to follow their own ideas without any reference to others have reaped a rich reward. —From *Automobile Engineer*, August 15.

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Legal Views on Contributory Negligence

A motor car was started from front of plaintiff's residence on a street at right angles with the trolley line, which was about 40 feet away. The trolley had head-lights and other lights and was easily seen at a distance of 700 feet. The chauffeur wished to turn right on the car street. As he turned a collision occurred. It came out on the trial that the car was going 20 miles per hour and the automobile 4 to 5 miles per hour. The Court said that as the chauffeur saw the car when he was about to enter the track and continued for 25 feet when he might have stopped or turned off, or speeded up and gone straight across, he was guilty of contributory negligence because he did neither of these things but went leisurely on his way.—*Bertrand vs. Milwaukee Electric Railway & Light Co.*, 146 *N. W.* (*Wis.*), 915.

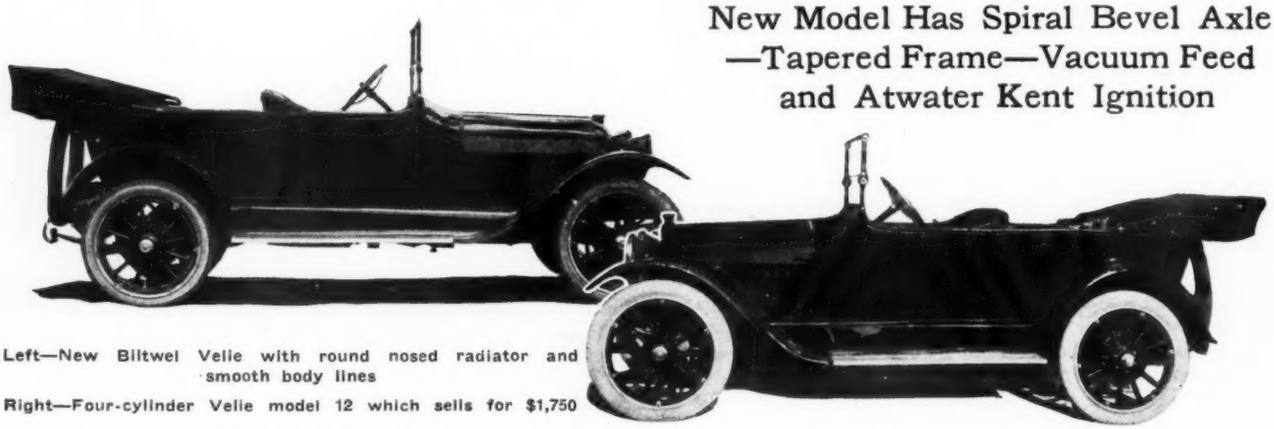
Speeding Across Railroad Tracks

The fact that a motorist kept on driving his machine at a high speed when he came to a railroad crossing was held by the Court in a recent case to be such negligence on his part as to prevent him from being successful when he sued for injuries for damages caused by a collision with the rear end of a freight train.

A motorist was driving at a high speed along a country road. On approaching a railroad crossing he did not slow down and collided with the rear end of a freight train which was on the roadway. The Court held that even if no warning gong was rung, he was not relieved from ordinary precaution for his own safety, but as he had his side curtains down and his windshield up it must be presumed that he knew he had only his sight and his knowledge of the location to depend on, and for that reason the railroad company was held free from liability.—*Farmer vs. N. Y., N. H. & H. R. R. Co.*, 104 *N. E.* 492.

New Velie Six $1,595—Two Other Models

New Model Has Spiral Bevel Axle —Tapered Frame—Vacuum Feed and Atwater Kent Ignition

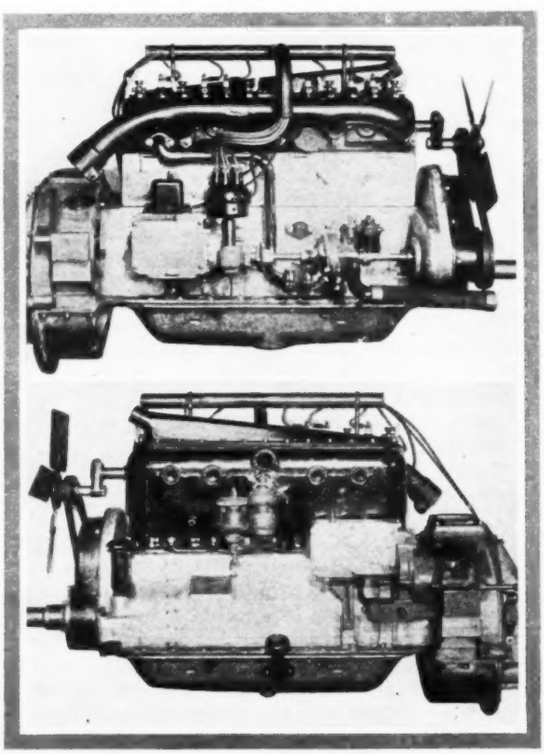


Left—New Biltwel Velie with round nosed radiator and smooth body lines

Right—Four-cylinder Velie model 12 which sells for $1,750

AN entirely new small six selling at $1,595 and called the Biltwel series 15 is the feature of the line of the Velie Motor Vehicle Co., Moline, Ill., for the ensuing season. Last season's small four, the model 11 has been discontinued and the big six, called series 14, this year and the big four called series 12, have been improved and reduced in price. The four has been reduced, from $2,000 to $1,750, and the six from $2,350 to $2,015. New bodies are featured on all the cars. In the new six the Velie company has incorporated a number of special features which have lately come into use by motor car builders. The spiral bevel rear axle gears is one of these features, the tapered frame, another, and it might be mentioned that the frame of the new Velie brings the distance between front spring centers to 27 1-4 inches. The rear of the frame is 37 inches wide and the front 29 1-4. Hotchkiss drive is another adoption. In this car propulsion is through the springs, eliminating the conventional radius rods or torsion tube. Stewart vacuum fuel feed and Atwater Kent ignition with automatic spark advance are other features used in the new small six which were not used on previous models.

The engine is a Continental, forming a three-point suspended unit power plant with a cone clutch and gearset made by the Warner Gear Co., Toledo, O. The engine cylinders are cast in block, have a bore and stroke of 3 1-2 by 5 inches and are of L-head design. The crankshaft is supported by three bearings and through helical gears operates the camshaft. The valves controlled by the shaft are 1 1-2 inches in diameter. The oiling system is a combination of circulating splash and pressure, the main bearings being fed directly by leads and the reciprocating parts by splash distribution.



Upper—Right side of Continental motor used in new Velie Biltwel six. The pump, Atwater Kent ignition system and generator are on this side

Lower—Left side of motor showing high mounting of the carbureter and position of starting motor. The construction of the fan bracket is clearly shown and the oil gauge is seen at the bottom of the crankcase

On the left side of the engine is a Stromberg model H.B. 2 carbureter of 1 1-4 inch. This carbureter bolts directly to the cylinders feeding to the valves through a cored passage in the casting. The carbureter air intake is connected to the exhaust manifold by a sleeve and pipe. Fuel feed is by the Stewart vacuum system in which a small tank is placed behind the dash while the regular fuel tank is in the rear of the chassis. The fuel is drawn into the small tank by motor suction and then fed to the carbureter by gravity, doing away with all pumps and air lines necessary with a direct pressure feed.

High-Speed Cranker

On the same side with the carbureter is a Gray & Davis small, high-speed engine cranker operating at 6 volts and turning over the engine through the medium of a toothed-flywheel. On the left side there is also an oil gauge attached to the lower portion of the crankcase.

On the right or exhaust side of the motor is the small-type Gray & Davis 6-volt lighting generator with the regulator installed on top of its casing. Next to the generator is the Atwater Kent distributor with wires leading from it into a conduit making a neat wiring installation.

The ignition system is fitted with a reverse-current switch. This switch is of the rotary type with four positions instead of two.

The electric system has all its wires housed in metal conduits and the headlight wiring is concealed. The headlights are supported by single props which house the wires. These headlights are of the double-type affording a means of using bright or diffused light. Every lighting circuit is fused, and there is a

combination switch installed which allows of any set of lamps being used. The tail light and dash light are wired in series, so if the dash light goes out the tail light is extinguished also.

The clutch is of the cone type with a 2 1-2-inch face with an angle of 12 1-2 degrees. Back of the clutch is a four-speed selective gearset, with the following motor-to-wheel ratios: First, 12.87 to 1, second, 6.73 to 1, third, which is direct, 4.08 to 1 and geared up fourth, 3.42 to 1. This gearbox is of the narrow type in which the countershaft is above the shifter shaft making a neat installation and taking up little room apparently.

The drive from the gearset is through an open shaft fitted with two Spicer universals to a Timken floating rear axle fitted with spiral-bevel gears. This type with its sliding action of the teeth offers a set more quiet than the straight bevel and may be called the mean between the worm and the ordinary bevel. The car's wheelbase is 124 inches.

The controls of the new Velie six have interesting points of advantage. The steering post for example, placed on the left side, has self-lubricating bushings. This post is of Gemmer make and has a large horn button at its center. To the right of it is the ball-joint gearshift lever. The ignition control has an auxiliary in the form of dry cells operated by a switch near the floor boards and within easy reach of the driver's right hand.

The new Velie frame has an unusual taper. The frame is 4 1-2 inches deep by 2 by 5-32 inch and because of its narrowness in front, only 27 1-4 inches between spring centers, the car has a very short turning radius.

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Continental Motor Used

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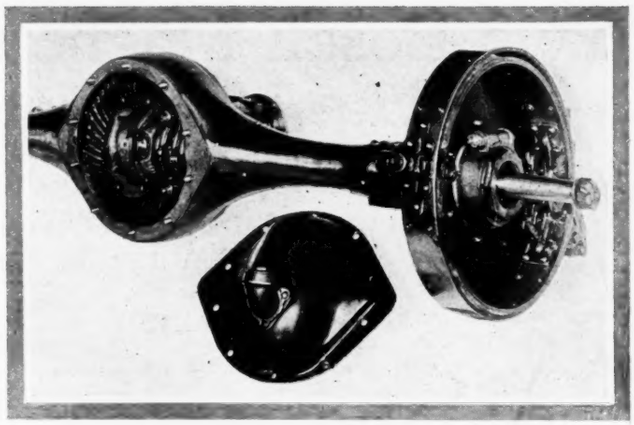

New Biltwel rear axle grease filler on axle cover

The price of the Velie big six has been reduced from $2,350 to $2,015 for the five-passenger. This and the seven are the only open types made. A sedan is listed at $2,715. Blue with Velie green optional are the touring colors while the sedan is sold only in blue.

The carried-over Velie four, shows the same general body lines as the other cars and the changes in this are the same as those made in the big six with one additional. This has been the increase in tire size from 36 by 4 to 37 by 5 1-2.

This car is the only one using a motor made in the Velie shops. It is of L-head design with pair-cast cylinders of 4 5-8 by 5 1-4 inches bore and stroke. A feature of this engine is the transverse magneto driven by worm gears, and set over the timing gear case. Another unusual feature is that the carbureter is on the right side with its intake pipe passing over the cylinders to the manifold on the left side. This forms a very accessible position for the Stromberg carbureter.

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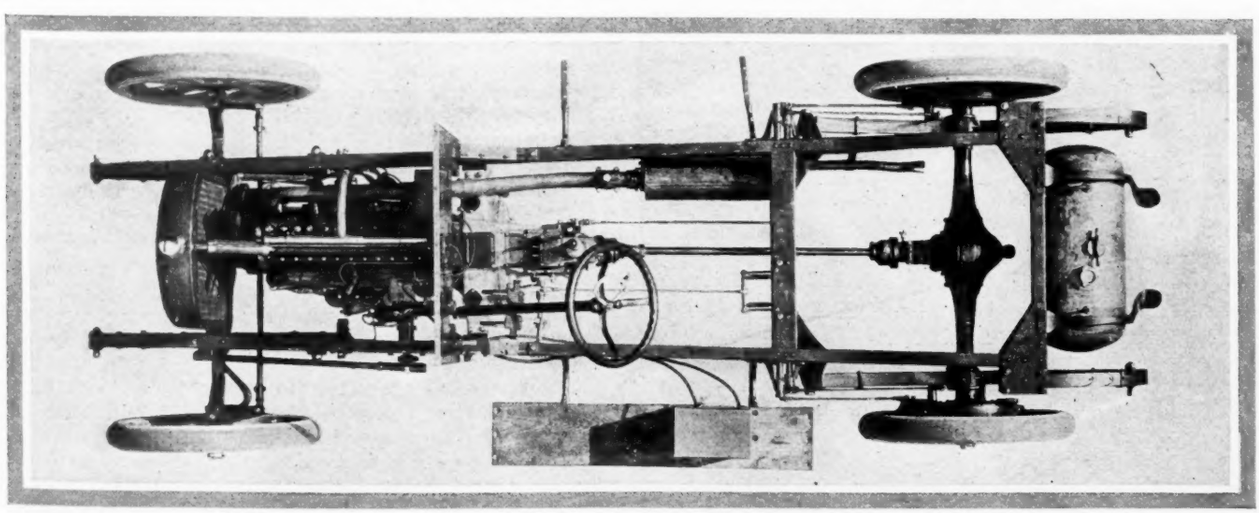

Plan view of new Biltwel Velie showing unit power plant construction and left drive with center control. The battery box is carried on the left running board and the gasoline tank is in the rear

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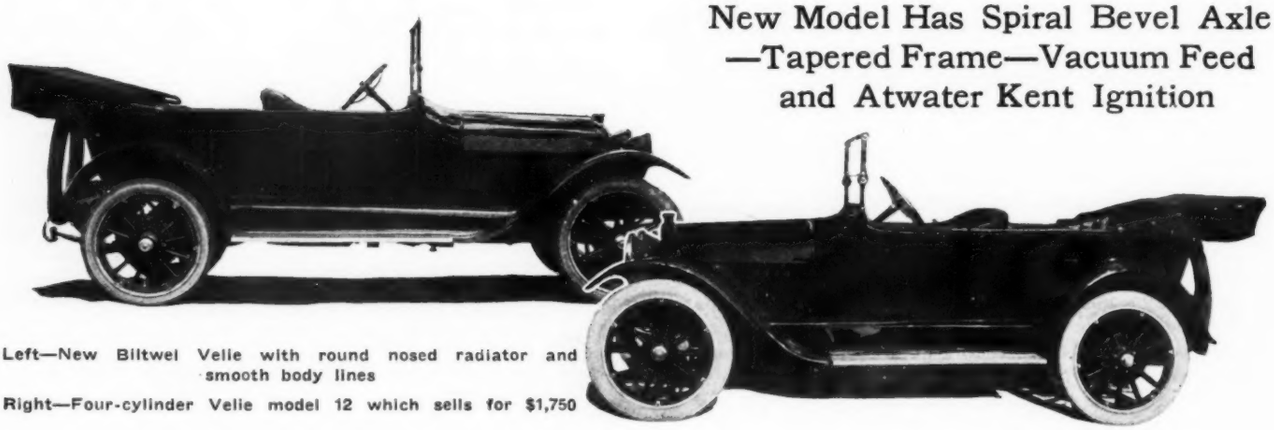

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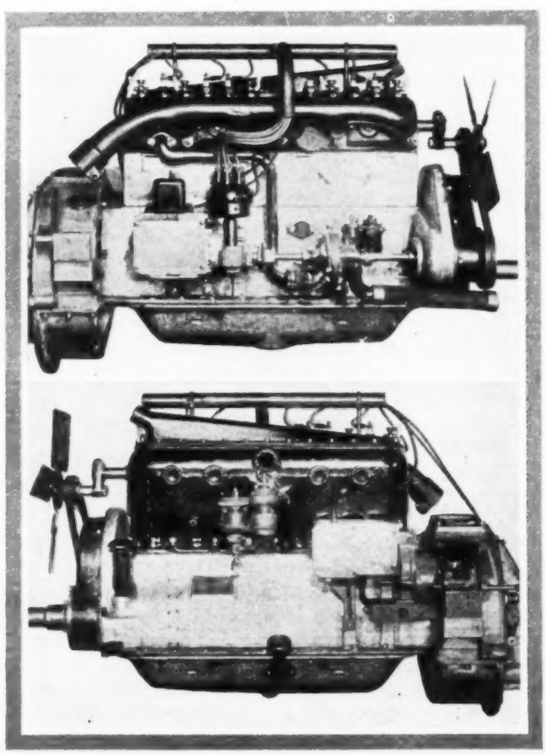

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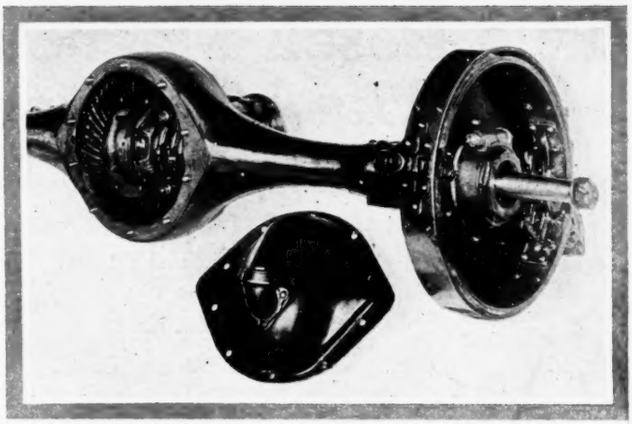

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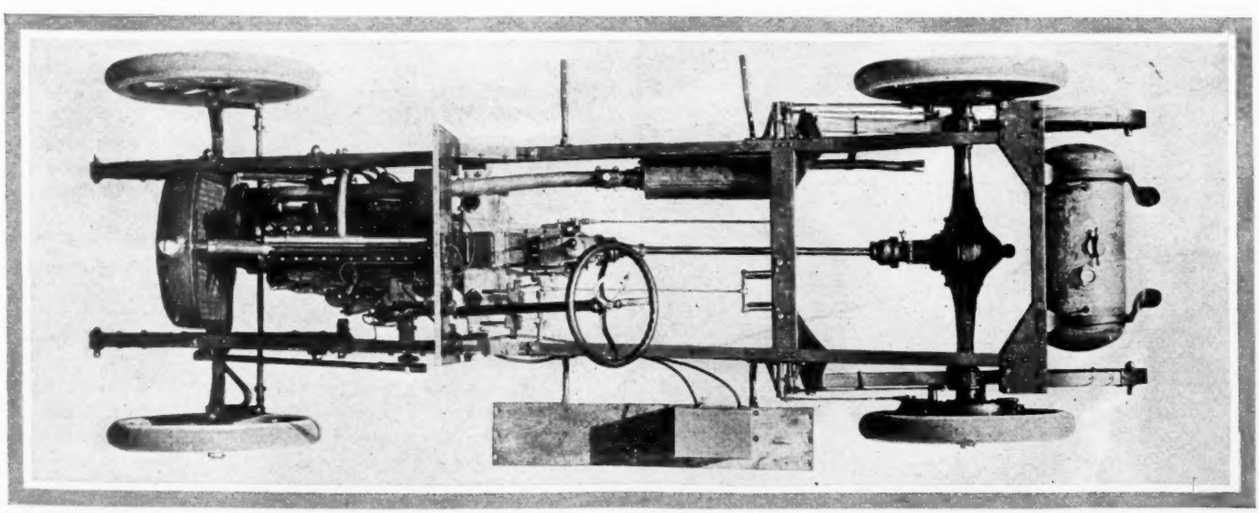


Plan view of new Biltwel Velie showing unit power plant construction and left drive with center control. The battery box is carried on the left running board and the gasoline tank is in the rear

Two Bosch Magnetos—One Has New Distributer

New Model With Collector Ring-Distributer for Small Cars—Other Model Gives Easy Starting, Called Vibrating Duplex System

TWO entirely new Bosch systems to meet the requirements of recent developments in automobile design have just been announced. They are a vibrating duplex system to make possible the certain starting of the motor when cranked at low speeds by the starter, and an entirely new design of high-tension magneto, Fig. 1, with a combined current collector ring and distributer to take care of the popular-priced, small four-cylinder car.

Simplified Magneto for Small Fours

With the placing on the market of several makes of small four-cylinder cars of light weight, the Bosch company has kept its product up to time by the marketing of a greatly simplified high-tension magneto especially designed for this work. By the elimination of the distributer as an independent unit of the magneto construction it has become possible to reduce materially the number of parts used in the manufacture of the magneto, making it exceedingly light.

The function of distributing the ignition current has been placed in the new instrument on the slip ring. The single slip ring however, has been replaced and instead a double ring has been substituted which not only acts as the collector for the high-tension current but as the distributer as well.

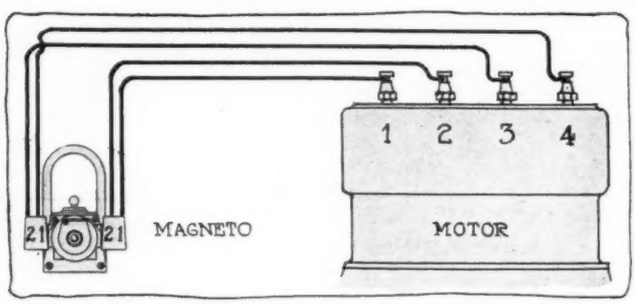


Fig. 2—Simple wiring diagram of new NU4 magneto without distributer

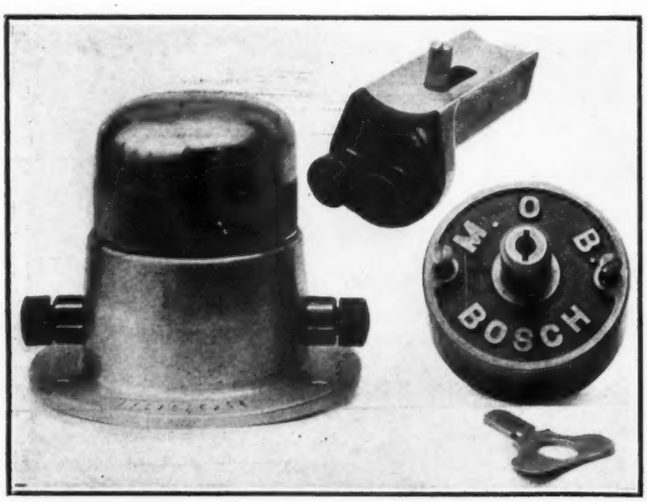


Fig 3—Components of vibrating duplex system. The inclosed vibrating coil is at the left and the dash switch at the right

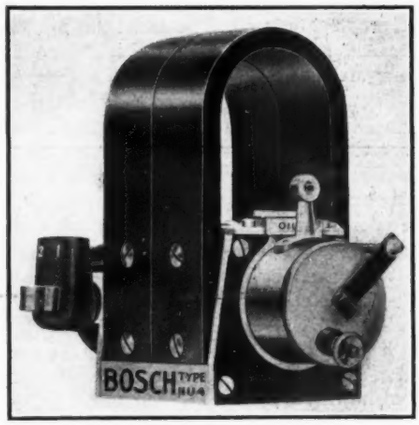


Fig. 1—New NU4 without distributer. The breaker box construction is conventional. A double slip ring takes the place of the distributer

Another new feature about the new Bosch magneto, which will bear the name NU4, is the use of two entirely separate armature windings. Hitherto the secondary winding in the Bosch magneto has been practically a continuation of the primary, its inner end connecting with the latter and the other end is led to the insulated slip ring or current connector ring which rotates solidly with the armature shaft of the instrument. From the slip ring the high-tension current is collected by a brush and led to a central point on the distributer block. It is taken from this point to the various plug points by a rotating brush.

New System on NU4

On the NU4, Fig. 2, an entirely different system has been worked out. The primary winding, as in other types, has one end connected to the armature core and the other end to the insulated contact block supporting the long platinum screw on the contact breaker. The breaker box mechanism is in every particular similar to that used on previous Bosch models. It is shown in Fig. 4.

It is in the high-tension winding that the first difference manifests itself. In the new model there is no connection whatever between the primary and secondary windings. In fact they are heavily insulated from each other. The two ends of the secondary winding are connected to two metal segments located on a double slip ring as shown in Fig. 7. This double slip ring is mounted on the armature shaft and rotates with it.

Bearing against the double slip ring are two pairs of brushes. Each of these four brushes forms the terminal of a spark plug wire. As the armature rotates the segments form a contact in turn with each of the four brushes sending the spark to the plug to which contact is made. The high-tension current is thus distributed without recourse to the ordinary type of distributer.

The keynote of the new magneto is the slip ring which so ingeniously takes care of the needs of the collecting and distribution functions of the magneto. It is made in one piece with two deep grooves in place of the single groove seen on other Bosch rings. It is of hard rubber insulating material. Imbedded in each groove is a metal segment. The two segments are set diametrically opposite on the armature shaft, that is, a distance of 180 degrees in angular measure. They are insulated from each other as well as from the core of the armature and the magneto frame.

The four brushes are supported by two double brush holders, as is clearly illustrated in Fig. 7. With this arrangement the magneto will give two sparks to each revolution from alternate segments on the collector-distributor ring. The brush holders fit into openings provided in each side of the driving shaft end plate and are held in place by catch springs. The brush holders together with the brushes can be pulled out of place without tools.

The NU4 magneto is installed so that it is driven at engine speed. As there will be a surplus spark in each cylinder 360 degrees behind the effective spark or one revolution of the crankshaft, the timing must be such that the inlet valve has not started to open at this time and so that the exhaust is preferably still open. Under average conditions this state of affairs is secured if the magneto is fitted so that the interrupter housing is in full retard position just as the interrupter screws are about to separate when the number 1 cylinder is on top center. At this time the metal segments of the slip ring should be in contact with the brush marked 1.

This magneto is suitable for installations up to 30 horsepower. It can be used as the sole source of ignition on engines up to this size, being of independent design. It can, however, be used to advantage in connection with the Bosch Duplex above described.

Vibrating System Instead of Dual

The vibrating system is designed to render unnecessary a dual ignition system on cars that are cranked by a starting motor at such a low speed that the ignition current from the ordinary magneto is insufficient to give certain ignition. Instead of using independent current supplied by a set of dry batteries or by some other source, the new Bosch system takes the primary current from the primary winding of the magneto and by means of an inclosed type of coil and a battery placed in series with the primary winding produces the high-tension spark necessary at the plug gaps.

The number of extra parts required with this new system is small. No additional wires running to the magneto are needed and the timing device which is already incorporated in the magneto suffices for the purpose of directing the spark to the proper cylinders. A further simplification of the system is secured by taking the connections necessary for the operation of the system directly from the starting switch instead of placing another switch on the dash.

When the starting pedal is depressed the vibrating duplex system is thrown in. The coil receives current from the battery as soon as the starting switch reaches its first contact point. The coil is so constructed that it will operate down as low as 4 volts. In other words the functions of the secondary winding in the magneto are for the time being fulfilled by the little vibrating coil. The contact is made, broken and timed through the breaker box of the magneto in the ordinary manner so that as far as the wiring of the magneto is concerned no alterations are necessary. A wiring diagram is given in Fig. 5.

In case the starting motor for some reason should fail to work the new duplex system also works to advantage. The Bosch company states that a special switch can be built into the starting crank end of the engine so that when the crank is in-

(*Continued on page* 597)

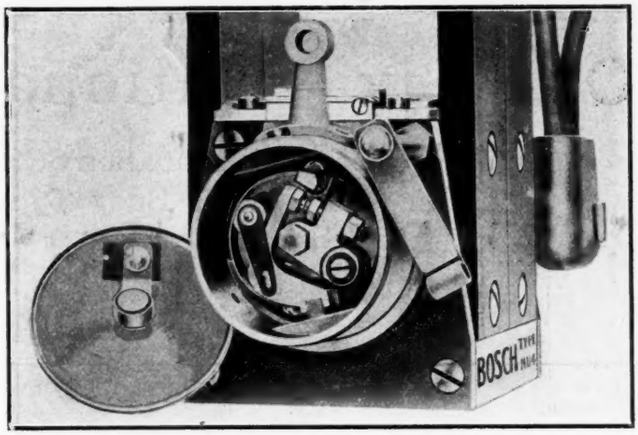


Fig. 4—Breaker box construction on new NU4. It is conventional

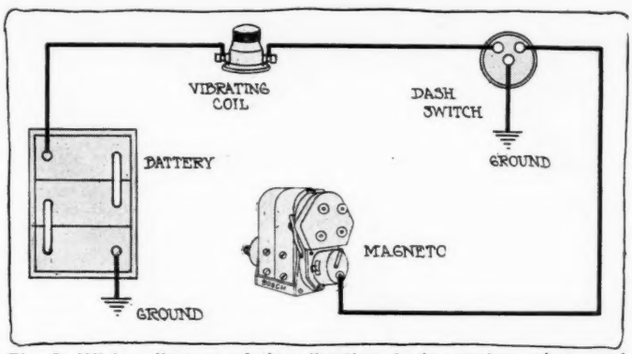


Fig. 5—Wiring diagram of the vibrating duplex system when used in connection with a starting motor

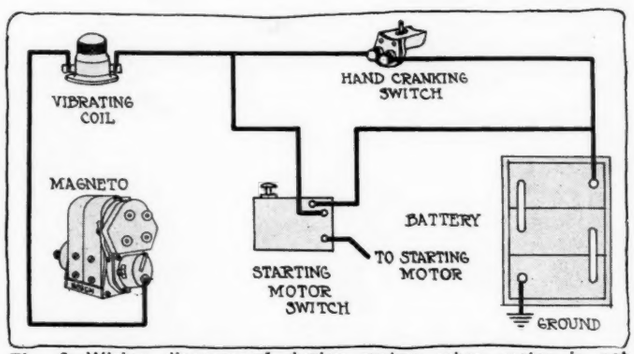


Fig. 6—Wiring diagram of duplex system when motor is not equipped with starter

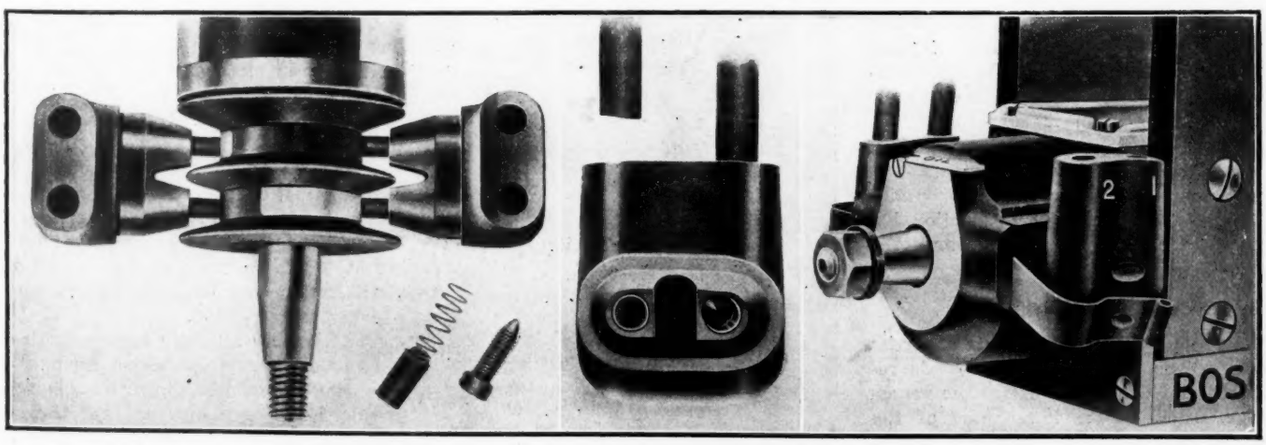
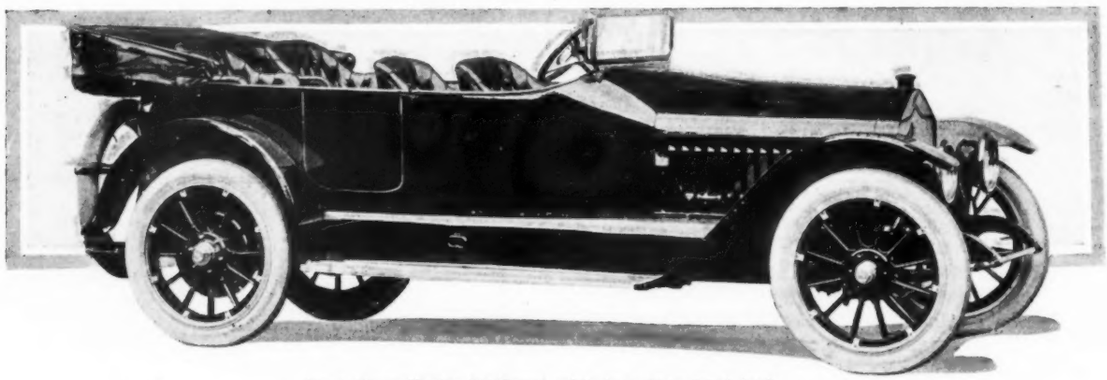


Fig. 7—NU4 magneto—Left to right—Setting of carbon brushes. Detail of double carbon holder—Brush holder construction

One Six—National Offering for 1915

This Chassis Continuation of Present Six—Boat Body Feature of Car—Five Other Body Types—New Electrical Equipment



New six-cylinder National with two-door boat body

FOR 1915 the National Motor Vehicle Co., Indianapolis, Ind., is building but one chassis, a six-cylinder type, which is a continuation of the 1914 design. This company, which for years has been a leading exponent of the four-cylinder design, is still bringing some of these through the factory, but after the present factory lot is shipped, four-cylinder styles will only be built on special orders.

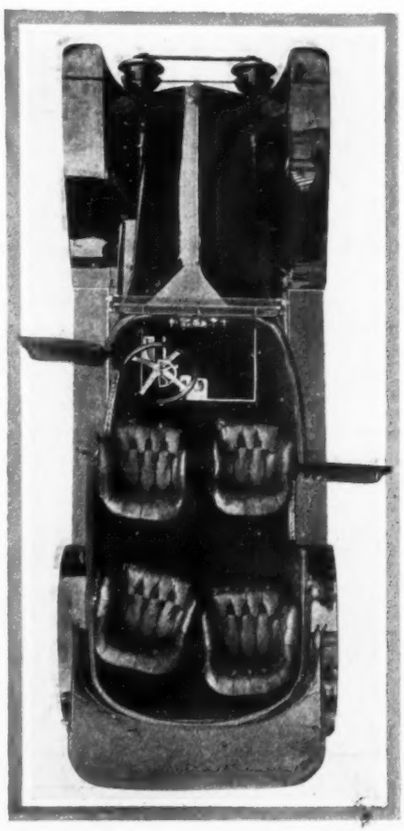
On the single chassis for 1915, not fewer than six different body types are fitted. Of these five are continuations of present styles with refinements, but the sixth is a new boat design which the company is introducing for the first time.

New Electrical System

The new cars are practically the same in price and essentially the same mechanically as the 1914, except for alterations as noted. Chief in these is an entirely new electrical equipment comprising the Eisemann magneto now used as the only source of current, and the Remy starting and lighting outfit, which replaces that formerly used. The Remy system is a 6-volt, double-wire one, with the starting and lighting units combined in one double-deck housing, but these are separate units so far as their operation is concerned. The cranking motor, a series-wound design, is capable of turning the engine at 100 revolutions per minute, even under adverse conditions. The reduction between the cranking motor and the crankshaft is 28 to 1.

Charges at 8 M.P.H.

As soon as the engine starts under its own power, the cranking motor is released and the engine drives the generator, which is the lower part of the double-deck unit. Between the generator and the crankshaft is a 2 to 1 reduction which allows the generator to start charging the battery at 8 miles per hour, and makes it capable of carrying the full lamp load at 12 miles per hour, at which speed the output is 12 amperes. The current regulation in the generator is by means of a bucking coil. Generator drive is by silent chain off the crankshaft.

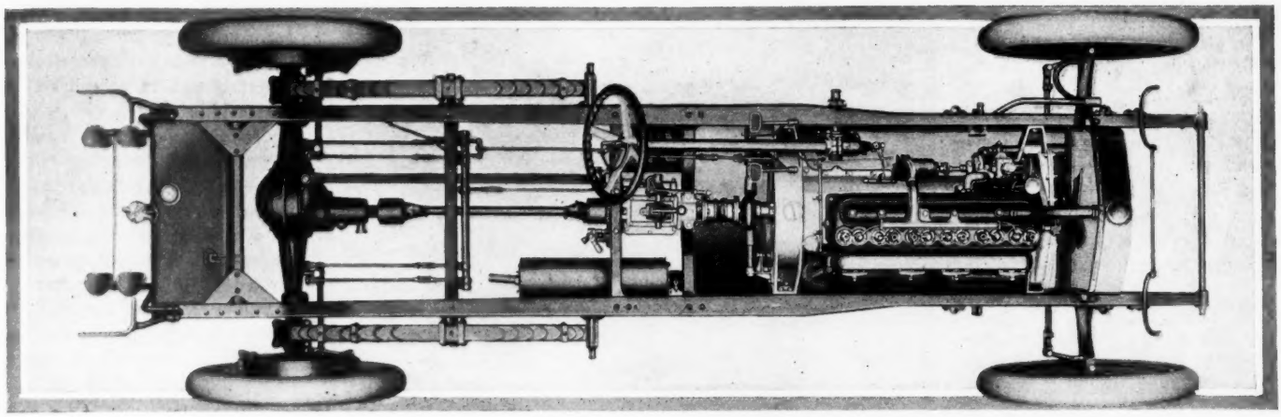


Plan view of boat body showing the novel arrangement of the doors and the individual chair seats that are movable

Most important in the body styles is that of the new boat type which was shown for the first time at the recent Michigan state fair. It has four deeply upholstered individual seats and one extra seat that folds into the rear extremity of the body. In form the body is similar to the upper part of the hull of a torpedo-stern motor boat. The four chairs are placed side by side, front and rear. Each chair is placed on a track that permits it to be moved forward or backward as desired. In addition there is a swivel arrangement by means of which the chair can be turned on its axis allowing the occupants to seat themselves tete-a-tete if they desire. The price of the new car fitted with the new body is $2,700.

In body work the streamline form has been adhered to throughout. The boat body is more extreme in this respect than the others. On all the other models the sides are straight while on the boat model it has a pronounced sweep. In addition to this body the company is continuing the four-passenger toy tonneau, five-passenger touring and two-passenger roadster, all listing at $2,375; a coupé at $2,750 and a six-passenger toy tonneau with disappearing seats, $2,500.

The cars are all fully equipped; tire pump, Collins curtains, extra demountable rim, windshield, horn, etc., being standard. Color is optional, but if not specified, National blue is furnished. Wheelbases of all but the roadster



Plan view of chassis showing the block motor, cantilever spring suspension and fuel tank location

model are 132 inches, the roadster model measuring 124 inches.

By following the modern trend in body work and making use of a mould rather than an angular body, the National company has in common with a number of other concerns, making a car of this size, clipped about 100 pounds from the body weight. In spite of this reduction in weight, the six-passenger body is longer and wider than in 1914. The extra seats fold into the backs of the front seats and are concealed when not in use by a leather flap that buckles over them. Another change is that the Willard battery is longer and narrower, making it possible to store it neatly in an accessible compartment beneath the splash guard.

Lighter Reciprocating Parts

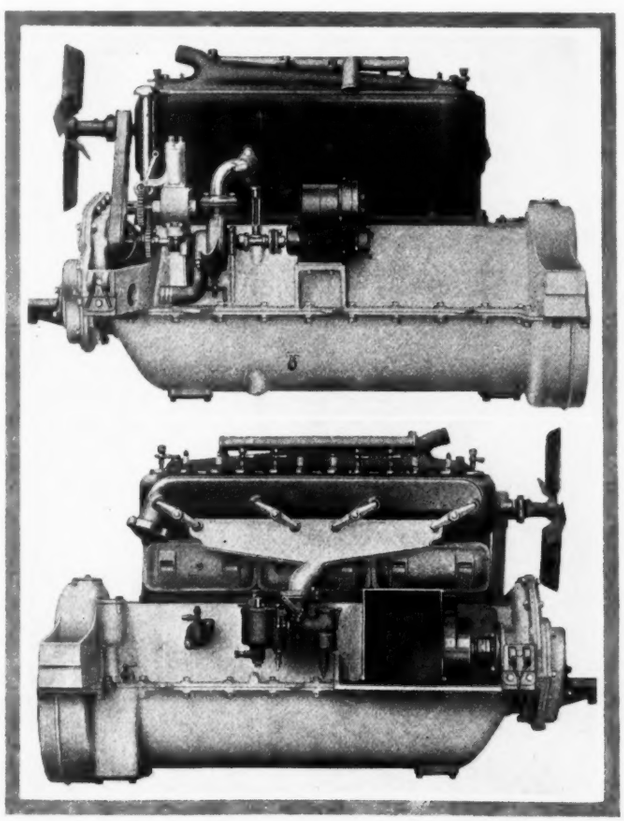
Twenty-five per cent. has been cut off the weight of the reciprocating parts of the motor for this season resulting in an increase in power and the elimination of vibration at high speeds. The crankcase is now a heavier casting adding still further to the rigidity of the construction. The oiling system remains the same in the principles of operation, but a vertical oil screen replaces the horizontal type and eliminates any chance of clogging because the oil cannot settle on the surface.

In the gearbox the travel of the sliding pinion has been increased by .25 inch. The purpose of this change is to make possible an easier gear-shift. The bearings of the rear wheels are now larger. In place of carbon steel the springs are now of silico-manganese. Another alteration in the spring, which is a cantilever design, is that it is now practically flat, whereas on the former National the spring had a pronounced arch.

The 3.75 by 5-inch power-plant is a six-cylinder block design with L-head cylinders. The intake and exhaust manifolds are cast separately. The exhaust manifold is of gray iron. The intake is aluminum and is cored so that the waterjacket space registers with that of the manifold allowing the water to circulate about the intake passages to assist vaporization before entering the cylinders.

The waterjackets are arranged with baffle plates so that the water is led from a point beneath the valves where it enters and makes a circuit of each cylinder before reaching the outlet at the top. The cylinders are fitted with a cover plate that is removable, permitting of access to the waterjacket space.

The gray iron pistons are fitted with four rings, and have an oil groove and holes drilled to allow the excess oil to escape rather than to find its way into the top of the cylinder and cause smoking. The open hearth steel, case-hardened, piston pins are ground to their finished size, the holes are bored and reamed.



Upper—Left side of motor showing the location of the magneto, water pump and power tire pump. Lower—Right side of motor showing the position of generator and arrangement of the piping

The connecting-rods, of open hearth steel, are I-beam in section and are drop-forged and heat treated. They are not offset and the upper bearing is fitted with a phosphor bronze bushing and the lower bearing is lined with babbitt against a bronze backing. Alloy steel bolts are used in holding the connecting-rod bearing caps in place.

The crankshaft, also of open-hearth steel, is heat treated, and is balanced on a Norton running-balance machine. It is supported on four main bearings. Its diameter is 2 inches at all the bearing points except at the rear where it is enlarged to 2.125 inches to take care of the weight of the flywheel. The length of the front main bearing is 3.125 inches; of the two center ones, 2.5 inches, and the rear 4 inches. The diameter of the crankpins is 2 inches and the length of the crankpin bearings is also 2 inches.

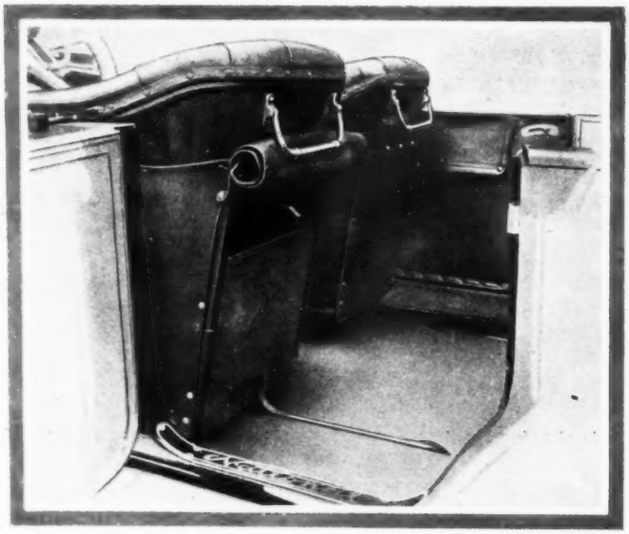
The camshaft, carried on four bearings, has the front one made large to take the

stresses of the drive from the timing gears. The connection between the cam gear and the shaft is made by means of a flange. The camshaft is completely inclosed and virtually runs in a bath of oil. The cams and shaft are a one-piece drop forging and the cams finished on a cam-grinding machine.

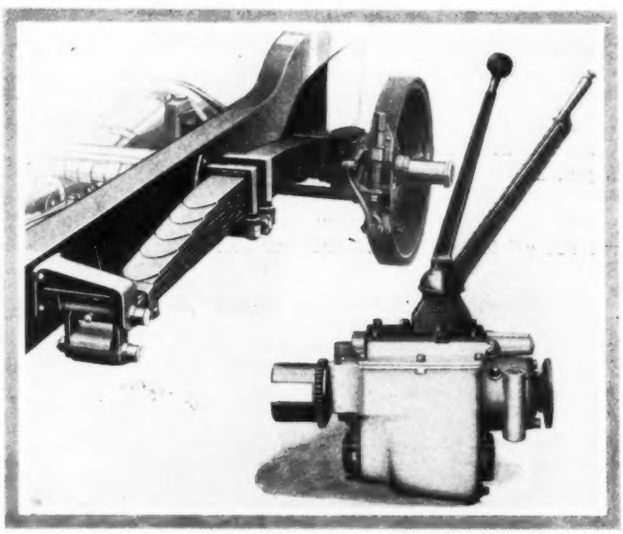
Valves All Enclosed

The entire valve mechanism is inclosed, the adjustment points being accessible by the removal of three cover plates. Each plate covers two inlet and two exhaust valves. The valves are of liberal diameter, 1 11-16 wide in the clear. The ends of the valve stems are hard and the push rods are of alloy steel. The stems and push rods work in separate removable bushings. The valve springs are oil tempered.

The oiling system is the same as that employed in 1914, in which the oil is carried in a reservoir in the lower half of the aluminum crankcase. From this reservoir it is pumped through a lead and separate tubes to each of the four main bearings. The oil which reaches the main bearings flows down on either side of the bearing into a series of splash troughs. When the level in these troughs rises to a certain height the excess is led back to the crankcase through overflow holes in the troughs. The filler tube for the oil reservoir is brought high up on the front end of the motor rendering it accessible. A float gauge is placed on the same side.



Method of concealing auxiliary seats on six-passenger body. They fold into the front seats and are covered by curtains



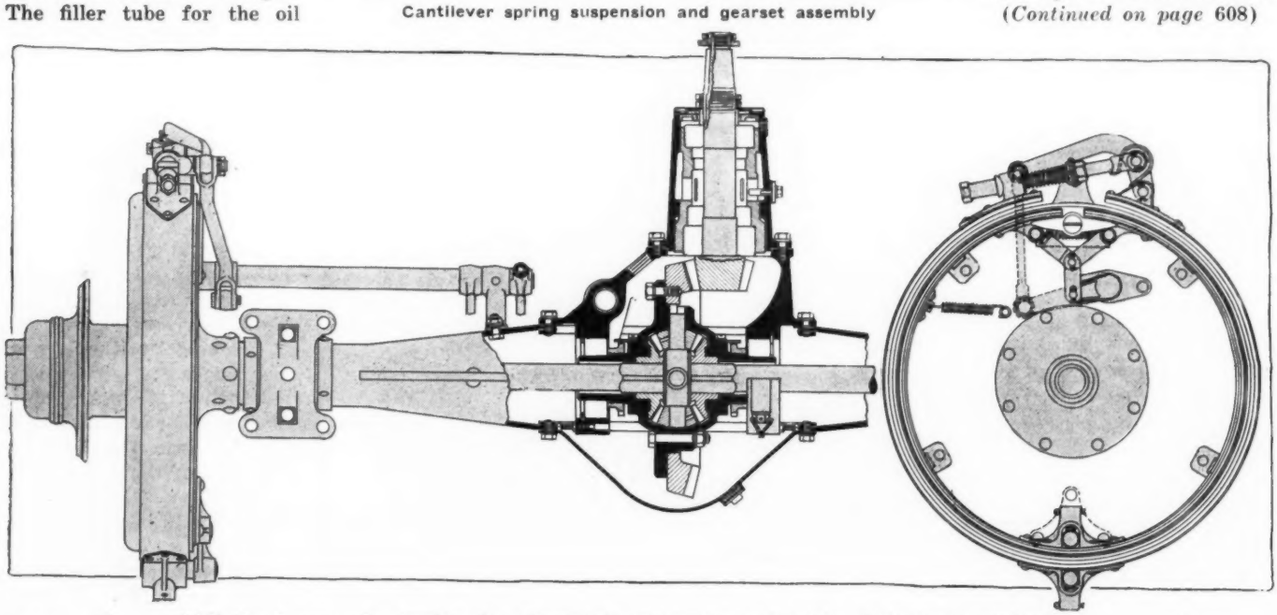
Cantilever spring suspension and gearset assembly

In the cooling system the centrifugal water pump placed on the left side of the motor at the forward end has the runner and bearings of bronze to avoid the tendency to corrode. Cooling is aided by means of a 16-inch steel fan, which is mounted on ball bearings. The fan bracket is movable for adjustment.

The gasoline system remains unchanged except that the newest Rayfield carbureter is fitted. This is the model G-3, 1.25 inch. The fuel tank is hung between the rear frame members and has a capacity of 21 gallons. The feed is by pressure, the pump for applying this pressure being mounted on the side of the motor and driven off the rear end of the camshaft. The gasoline tank is fitted with a gauge and the filler neck is extended back to provide for accessible filling.

Power is transmitted by means of a cone clutch, a type used in the National since its inception. Beneath the surface of the leather are flat springs which are compressed in engagement. These give a firm grip. The three-speed gearbox is the same design as previously used with the exception before noted on the increased travel of the shifter pinion. This increased

(*Continued on page* 608)



National rear axle showing the differential construction and details of the brake mechanism

More Graceful Lines on Waverley

(*Continued from page* 577)

bearings and the inner sides are kept dust proof by means of felt washers. The other bearings throughout the car, notably in the motor and the transmission units are annular balls.

The spring suspension is unique in that it employs the seldom-used, five-quarter elliptic both front and rear. A layout of this suspension is illustrated herewith. The engineers claim for this type of suspension all the advantages of the full elliptic for softness and of the cantilever in the absorption of road shocks.

A double set of expanding brakes is used on all Waverley cars, and in addition to this the driver has at her or his disposal a third, and very effective brake on the motor. The latter is a band contact type and the differential acts very effectively as an equalizer when this brake is used.

The replacement of the previous four-chair brougham, known as the 107 by the 109 model keeps the Waverley line of passenger cars at five bodies. These with their selling prices are as follows:

Model	Body	Price
109	Four-chair brougham	$3,150
104	Front drive, four passenger	2,900
105	Rear drive, four passenger	2,800
108	Limousine, five passenger, forward drive	3,500

The body work on the new model is the result of a special effort to put out the most luxurious possible town car at the price. The roof and panels are of aluminum. The length of the car over all is 149 inches, the extreme width 66 inches. Of the length 131 inches is taken up by the body. The wheelbase is 106 inches. All four seats are large enough to accommodate people of more than average stoutness. Two of the rear seats are 18.5 by 20 inches, the other rear seat is 23 by 20 and the driver's seat is 18 by 15.5. The road clearance is 10 inches and the step to the ground 14 inches.

The upholstering work is optional. It may be in any of the imported corded fabrics or of special limousine leather. The standard color is black with majestic blue panels, but the car will be painted to suit the demands of the individual. The tires are 34 by 4 inch front and 34 by 4.5 rear. They may be cushion or pneumatic at the same price.

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New Velie Six, $1,595—Other Models

(*Continued from page* 591)

Propulsion in this new six is through the springs constituting what is commonly called the Hotchkiss drive. As assurance that the springs will not be overburdened the main leaf is made of alloy steel. The front springs are 40 inches long and the rear 52 both having leaves 2 1-4 inches wide. The wheelbase is 124 inches and the wheels fitted with 34 by 4 inch tires on Goodyear endless demountable rims for straight-side tires. The front wheel camber is 1 1-2 per cent.

The high spots have been reached in the matter of body style and equipment. The Biltwel body is the exemplification of the streamline idea. There is a graceful curve from cowl to a new-type of rounded radiator the sides are straight and the back, bell-shaped. The symmetry of the car has not been broken up by anything, for the designers have gone so far as to install a 20-gallon cylindrical gasoline tank in the rear. The top when folded back and covered gives a clean appearance for the top-cover also protects the bows. A feature of this body as well as the others of the line is that they are fitted with anti-squeak strips. Many owners who have had experience with new cars know that many cars will emit body squeaks for the first few months they are in service, but this inconvenience has been eliminated in the Velies by the use of strips at points where squeaks might occur.

No wires are attached to this body, hence it is an easy matter to remove the body without disturbing the wiring. This is due to the fact that a junction box to which all wires are attached, is employed.

Nothing seems to be lacking in the list of equipment. Besides the ordinary accessories, given, the new six is equipped with a Taylor Noil tire pump, a windshield with supports fastened to the body sills, auxiliary emergency battery for ignition, double headlights, gasoline gauge, inspection lamp, tire carrier, and electric horn with control button in the center of the steering wheel.

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Two Bosch Magnetos—One Has New Distributer

(*Continued from page* 593)

serted in its place it automatically closes the circuit and throws the vibrating coil into operation. It must be understood, however, that the system is not intended to displace the separate battery system as a source of running current. It is merely for starting purposes and at all other times is not in use.

One of the chief uses for a system of this nature is for women drivers who through the failure of the starting system due to a nearly-discharged battery are compelled to fall back on the starting crank. In an incident of this kind the motor could readily be started with a turn of the crank provided at least 4 volts are available.

Cars not equipped with starting motors can also make use of the system to provide a means of easy starting without an entirely independent battery ignition. It is also possible to eliminate dash complications in the installation of the switch when there is no starting switch to make use of. A wiring diagram showing how this can be accomplished is given in Fig. 6. Only one wire running from the switch to the magneto is employed. When the switch is in the off position, this wire conducts the battery current from the vibrating coil to the magneto primary, thereby assisting the magneto at low or starting speeds. Fig. 3 shows the component parts of the system including the switch which can be built into the starting crank end of the motor.

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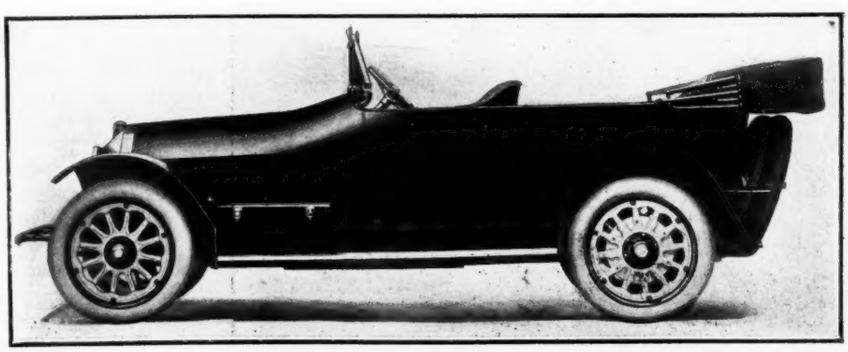
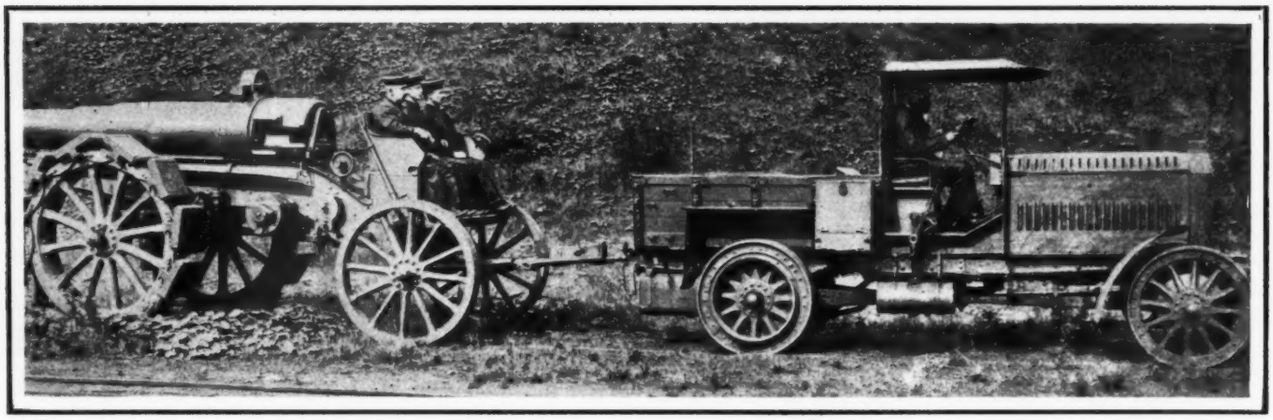
Seven Passenger Pathfinder for $2,322

One more model has been added to the Pathfinder line. This is a seven-passenger car of distinctive design selling at $2,322. It is mounted on the standard Daniel Boone chassis, which was fully described in THE AUTOMOBILE, June 11. The extra tonneau seats on this car fold forward into the backs of the front seats.



New Pathfinder seven-passenger six selling for $2,322



Big German siege gun drawn by a powerful tractor. Note the traction blocks used on the trailer that carries the gun

Scenes Near Paris—From An Automobile

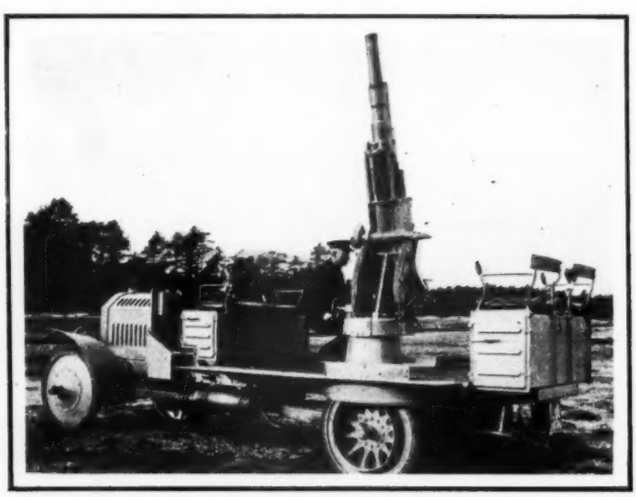
Roads from City Crowded With Refugees—Main Routes Barricaded—Buses for High-Speed Transport—Traveling Difficult

By W. F. Bradley

PARIS, Sept. 15—Playing at last out of Paris was a somewhat risky business, for nobody knew exactly at what moment the doors would be shut, holding those on the inside prisoners and making it difficult for those on the outside to get back again. Having placed an automobile just on the outside of the fortified wall, I was able to get away after the official shutting down of the city in preparation for a state of siege.

This was touring under full war conditions. Before I had been on the road 5 minutes a Maurice-Farman armored biplane was seen making its way over Paris.

That main road out of Paris was crowded with peasant refugees, obliged to leave their homes within the line of fire of the forts. In their lumbering wagons they carried everything they could possibly save: bedding, pieces of furniture, hens, ducks, rabbits, goats, birds. Such cattle as they possessed followed. Of automobiles there were none. Nearly everybody possessing a car had fled from Paris when the first alarm had been given that the city might be invested.



Special aeroplane gun mounted on a Mercedes truck

Ten miles out the scene changed. As everybody is aware, there is a belt of forts around Paris, each fort being connected up with its neighbor by suitable entrenchments. Naturally the forts themselves are invisible, but I was soon aware that I was in their neighborhood by a soldier appearing in the middle of the road and pointing a bayonet at my radiator. The road, which is dead straight at this point, was blocked by strong earthworks thrown up to a considerable height. There were two barriers, each one occupying half the road, but separated one from the other by about 8 or 9 yards. It is possible for vehicles to zigzag through, but no car could get through by surprise.

The main road being forbidden, a detour had to be made through country lanes. This brought me into sight of scientifically cut trenches in the beetroot fields. They were so disposed that one would never have suspected their presence even at a distance of a few yards. Half an hour on the lanes, and I was back again on the main road, still cut up by barricades. At frequent intervals a soldier stepped out, examined my papers, and ordered me on.

A couple of miles further on I had to draw in to one side to allow the passage of a convoy of Paris motorbuses transformed into meat wagons. They traveled in a procession of half a dozen each with the regularity of a train. All the bright paintwork had gone, the bodies were scratched and battered, but the mechanism had been kept in the best of condition. It is testified by all that these motorbuses are doing excellent work in keeping the troops supplied daily with fresh meat. They contribute considerably toward the rapid movements of troops necessary under modern war conditions.

A civilian traveling through a war ridden country cannot hope to maintain a high average. But even 15 miles an hour on a day's run is better than 5 or 6 miles on the few trains given up to non-combatants. A batallion of military cyclists had to be overtaken. It is a matter of time and patience, particularly when army trucks come along in the opposite direction from time to time, and it is necessary for the civilian to lose all the ground he has gained to give the army the right of way.

Late in the afternoon an important body of troops was met on their way to take up positions on the hills dominating the valley. It was necessary to get on the grassy bank and give them the whole of the road. For nearly an hour I had to stay there while cuirassiers, dragoons, artillery and stores passed along. The line of troops was broken from time to time by a convoy of automobiles.

The value of the French subsidy system was apparent in this service. All these vehicles had been requisitioned in the North of France, as was evident from the names of the owners on the bodies, and were put at the disposal of the troops who happened to be stationed in that neighborhood. They were all 2 1-2-ton Latil models, and although they came from different businesses the fact that they were of uniform power, speed, and capacity made it possible for them to give excellent united service.

It was necessary to cross the river Seine by ferry, at a point which shall also be nameless. To get to the river side required a considerable amount of patience and diplomacy. The civil guards on duty there would have much preferred a local pass to the one issued by the head authority in Paris. When they had been convinced against their will, I was taken over. At the same time a convoy of British motor lorries was crossing in batches of three and four. In conversation with the drivers it was learned that the army had got over its first difficulty by abandoning the vehicles which were not suitable for service in France. At the outset a number had been sent over without sufficient examination, and by reason of mechanical defects had become a drag on all the others. One division had abandoned fifty of these derelicts. Owing to the language difficulty and to the lack of knowledge of the country, the British vehicles had to be much more closely convoyed than the French. Each group had attached to it some type of car with an officer interpreter aboard. The French had no need of such service, and were only attended when operating in dangerous country.

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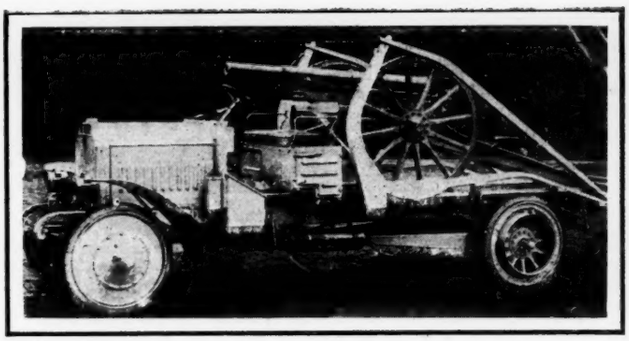
Racing Drivers Have Important Rôles

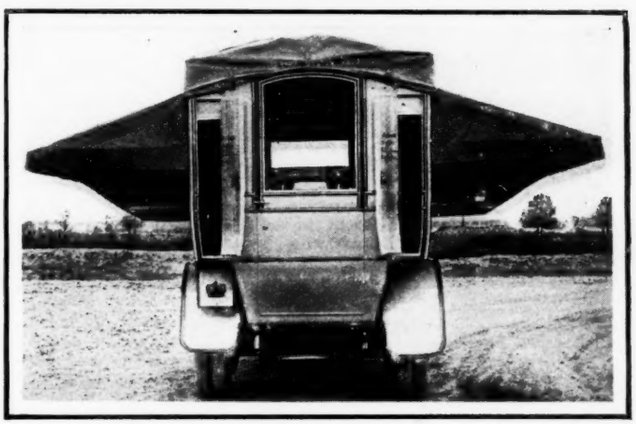
PARIS, Sept. 1—Rene de Knyff, chairman of the Racing Board of the Automobile Club of France, who is of Belgian origin, has just been granted French citizenship and has been accepted as an automobile volunteer in the French army. De Knyff is driving a powerful Panhard-Knight and has with him as chauffeur M. Artauld who did some very fast work on a Panhard in the recent Boulogne meet. This car is working between Paris and the eastern frontier.

Arthur Duray, who is also of Belgian origin, has been accepted as a volunteer automobilist in the French army. Duray offered his services as soon as war broke out, but regulations obliged him to wait until the twentieth day. When he had donned the blue uniform and slung a revolver case over his shoulders he took the wheel of a Turcat Mery car and was sent the same day to the eastern frontier. Duray went with his usual boisterous joyfulness.

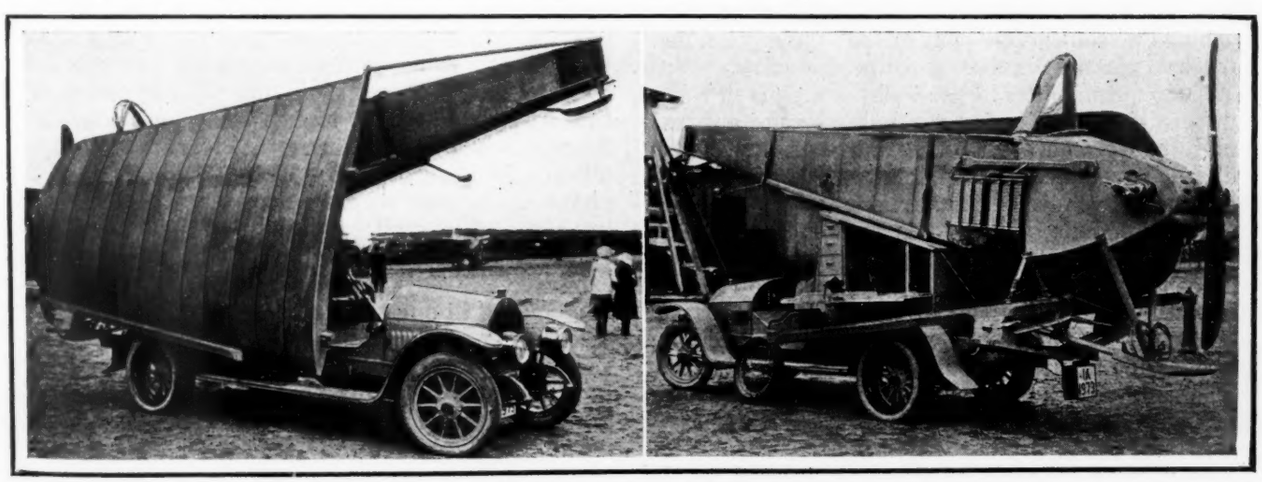
Practically all the men who took part in the recent Grand Prix at Lyons are now under military orders. The full Peugeot team is represented: Boillot and Rigal are driving cars; Goux is an artilleryman at Belfort. The Delage team has Duray and Guyot at the front, Bablot in the reserve, and Chief Engineer Michelat in charge of the headquarters staff automobile reserve. Champoiseau and Gabriel of the Schneider team are at the front. Tabuteau of the Alda Company is an aviator. Rene Thomas, the Indianapolis winner, was not eligible for military service and has been making every effort to be accepted as a volunteer. He has only just succeeded.



Method of carrying artillery used by the German army



Special field kitchen employed by the Kaiser



German monoplane mounted on a powerful Benz chassis. The wings are folded on one side and there is space for tools and repair parts

The Automobile

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$20,000,000 from Gasoline

THE government purposes by its emergency war tax measure to raise $20,000,000 revenue in 12 months from its tax of 2 cents per gallon on gasoline, motor spirits, naphtha and every other motor fuel which can be used in hydro-carbon engines.

According to the present scheme of taxation, the gasoline motor industry is to pay approximately one-fifth of the entire emergency war tax, which it has been estimated will approximate $100,000,000 or not more than $120,000,000 per annum.

This is a tremendous burden that the government purposes placing on the gasoline industry. With 1,500,000 automobiles in use today it means in round numbers that each motor car will average approximately $15 or more. A large share of this burden will fall on commercial vehicles which are used in the regular avenues of industrial transportation.

The automobile industry has been one of the most progressive and revolutionizing industries of the current century, and it is rather unnatural to look for one of the vital industries of the country to pay so heavily for an emergency war tax. Every citizen expects that luxuries should be taxed, in fact, that they should pay the majority of the tax, but here we find a new industry being called upon to carry nearly one-fifth of the entire burden.

The present schedule of taxes as drafted by the Ways and Means Committee places a burden on one form of transportation but not on another. In a word, if the transportation of passengers and freight is to be taxed, then all means of such transportation should be taxed alike. If we tax gasoline we should tax coal, we should tax wood, we should tax electric current, we should tax natural gas, we should tax producer gas, we should tax all of the provender consumed by horses and other animals of transport; in fact, we should tax everything that serves as a fuel or force in transportation.

There is no reason why the gasoline motor vehicle should be selected as one particular form of transportation to pay a war revenue tax. The gasoline vehicle is as much a utility today as the steamboat crossing the ocean, as our limited trains, as our freight trains, as our trolley cars, as our horse trucks, as our horse cabs, in fact as any means of transportation. None of these can be looked upon as luxuries; they are necessities.

The present European war is proving that the motor vehicle is one of the great factors in it. This is the first great motor war. The motor vehicle is superceding the horse in practically every arm of the service except cavalry. Why then, in all fairness, should we tax the gasoline which these vehicles use, and not tax the gunpowder used in the ammunition in the war, not tax the food used by the men fighting on either side, not tax the Red Cross supplies which are playing their part in the war.

The present agitation for a tax of 2 cents per gallon on fuel is both unreasonable and unjust. The makers and users of gasoline motor vehicles stand prepared to carry their share of this war revenue tax, but they do not stand prepared to carry one-fifth of it and let other means of transportation not using gasoline as a fuel go free. This is a case which calls for plain justice. If the gasoline truck hauling gravel for the contractor must pay a tax of 2 cents per gallon on its fuel, then the trolley car on the city street should pay its ratio on electric current used; then the electric truck used in hauling freight must pay its share; then the passenger and freight elevator in the skyscraper must pay its share. The owner of the horse vehicle who drives down Fifth avenue to his office must pay his share. All must contribute if one contributes.

This is a movement in which manufacturers, dealers and owners should unite in using their influence, not in opposition to raising revenue for a war tax, but in objecting to one form of transportation being singled out to carry such a share of the burden while other forms of transportation are allowed to go scot free. They should oppose this phase of the war revenue tax on the ground of the injustice of levying on such a necessity in life as transportation. It enters into every phase of our existence. It plays its part in all of the food we eat. It is needed in our every movement in life excepting when we walk, in both business and in pleasure. Transportation is the life blood of the present age. It is the greatest movement of the centuries. We have no more right to tax it than to tax the telephone, the telegraph, the wireless, or the post office, or parcel post. All are alike. All are equal in the mission they have to perform.

Congress May Tax Gasoline 2 Cents

WASHINGTON, D. C., Sept. 21—*Special Telegram*—The war revenue tax bill introduced into the House to-day provides a tax of 2 cents per gallon to be assessed against the producer on gasoline, naphtha, and other products used for motor power. Should this tax be imposed it will mean that approximately one-fifth of the total war revenue tax will be raised from this 2 cents per gallon on different fuels for motor use.

If this provision is enacted into law, the method of collecting the tax will be in accordance with the rules and regulations formulated by the Commissioner of Internal Revenue with the approval of the Secretary of the Treasury. The bill is to become effective on the date of passage, but the stamp tax section will remain in operation only until December 31, 1915. The tax on gasoline evidently will remain in force indefinitely.

The war revenue tax bill will be taken up in the House of Representatives on Sept. 24 under a special rule to make it a privileged matter. An effort will be made to limit debate on the measure. According to information from the ways and means committee gasoline will be taxed 2 cents a gallon, but there is a probability that the Senate will throw this out of the bill and substitute some sort of a federal tax on motor cars not used in business.

The proposition to put a tax on gasoline is sure to arouse a storm of protest, and while the House may jam the proposition through, it is believed almost certain that the Senate will vote to eliminate the House provision. The matter will then go to conference and some highly interesting developments may be looked for.

The measure, as it will be presented to the House of Representatives, contains scores of items to be taxed, many of them taken bodily from the Spanish war tax of 1898, but a welcome relief to business men is the absence of a stamp tax on checks. The members of the Ways and Means Committee left out this troublesome item because it had been found by Treasury Department experts that the business of the country had increased to so great an extent that items other than checks could be taxed slightly and bring up the total of the bill's results to about $105,000,000 in a year.

Republican members of both the House and Senate have gone on record in opposition to any war tax measure. The Democrats hope to rush the bill through the House and the big fight against the bill will be in the Senate.

Just what sort of a tax the Senate will attempt to place on pleasure motor cars is unknown at this time. Members of the finance committee, which will handle the Senate bill, decline to give any information on the subject.

The emergency war tax bill was ordered reported to-day by the Ways and Means Committee and will be called up in the House Thursday. The Rules Committee will meet tomorrow to frame rules to rush the bill through the House committee. The Democrats added an amendment to the gasoline section, the words motor spirits being added so that the section will embrace all products used for motor power. The committee expects gasoline to produce $20,000,000.

Important Papers Scheduled for Truck Convention in Detroit

NEW YORK, Sept. 22—The first draft of the program for the Motor Truck Convention to be held in Detroit, Mich., October 7, 8, 9 and 10, shows that papers of particular interest will be handled by representatives of the different truck makers on all days of the convention. The Wednesday afternoon program is framed largely for truck manufacturers. On Thursday the papers scheduled are of special interest to both manufacturers and dealers. Friday is dealers' day and the subjects on the program for that day treat with practically all the difficult problems that the motor truck dealer is face to face with.

No other subject will attract greater attention than the tire question for motor trucks which is scheduled for Thursday, October 8. J. E. Hale, of the Goodyear Company, and S. V. Norton, of the Goodrich company, are listed to handle different aspects of the truck question.

Such important questions to motor car makers and dealers as traffic engineering, how to calculate costs, the trading evil, etc., are the subject of papers by well qualified truck manufacturers.

Up to this date the entire program is not complete, but the program as promised by the different representatives who have been asked to assist is as follows:

WEDNESDAY, October 7. Afternoon Session—2:30 to 5:30:—Time Payment Plans for Trucks, Walter B. Parker, Commerce Co., Detroit, Mich.; Territorial Lines for Dealers, T. R. Lippard, Stewart Motor Corp., Buffalo, N. Y.; Evils of Overloading and Overrating for Trucks and Permissible Body Rates, H. W. Alden, Timken-Detroit Axle Co., Detroit, Mich., and John Utz, Perfection Spring Co., Cleveland, Ohio.

THURSDAY, October 8. Morning Session—9:30 to 12:30:—Lists, Discount for Quantity Business, Discounts for Parts, etc., M. L. Pulcher, Federal Motor Car Company, Detroit; Traffic Engineering, R. W. Hutchinson, Sternberg Mfg. Co., Milwaukee, Wis., and E. L. Shoemaker, Denby Motor Truck Co., Detroit, Mich.; Export Selling Methods and Requirements for Motor Trucks, J. B. Crockett, New York City.

THURSDAY, October 8. Afternoon Session—Sales Assistance to Dealers, C. W. Moodie, Standard Motor Truck Co., Cleveland, O.; Standard Tire Sizes, J. E. Hale, Goodyear Tire & Rubber Company, Akron, O.; Cost and Evils of Overloading and Overspeeding in the Truck Tire Field, S. V. Norton, B. F. Goodrich Co., Cleveland, O.

FRIDAY, October 9. Dealers' Day—Manufacturers' Guarantee of Service to Owners, W. L. Day, General Motor Truck Co., Pontiac, Mich., will champion this from the makers' viewpoint, and J. H. Thompson, Thompson Auto Co., Detroit, Mich., from the dealers' viewpoint: Central Market Reports, H. M. Allison, Chicago Auto Traders Exch., Chicago, Ill.; The Trading Evil, W. K. Chilcott, General Motors Truck Co., Pontiac, Mich.; Demonstrations, necessity and Charges, J. A. Ayers, General Motors Truck Co., Detroit, Mich.; The Driver's Relation to Successful Motor Truck Operation, C. P. Cary, Federal Motor Truck Company, Detroit, Mich.; How to Calculate Costs, R. W. Hutchinson, Sternberg Mfg. Co., Milwaukee, Wis.

Olympia Show Abandoned

LONDON, ENGLAND, Sept. 21—*Special Cablegram*—Owing to the war, the annual Olympia show, scheduled for November, will not be held. The Institution of Automobile Engineers will carry on its regular program of sessions but all papers will as far as possible have relation to the position of the industry in regard to the war.

The sale of light cars for home use is practically dead. Export trade, however, in light cars is fairly brisk and it is only this trade that is keeping the factories building small cars, open.

Such firms as Rolls-Royce, Siddeley, Starr, Austin, and others making small cars are today turning their attention to the construction of commercial vehicles, and other firms building passenger cars are doing machine work for the makers of heavy commercial vehicles. A considerable proportion of all plants is employed exclusively for government contracts.

The commercial vehicle industry is booming. All types of commercial vehicles with a load capacity of under 3 tons are finding ready sales, these naturally going to business houses to substitute horse haulage.

All builders of commercial vehicles of 3-ton capacity and over, such as, Leyland, Thorneycroft, Dennis, Straker, Karrier, Page-Field, Maudslay, Wolseley, and Daimler, are busy in the construction of vehicles for the government. The supply does not meet the demand. These companies have generally turned their entire factories over to the commercial vehicle use, that is, where a fraction of the factory has been engaged in making passenger vehicles, this fraction is now manufacturing trucks.

Greece to Purchase 300 Trucks

NEW YORK CITY, Sept. 22—There is now before the War Department of the Greek Government a project to purchase between 300 and 400 motor trucks at a cost of $1,000,000 to $1,200,000. The Kissel Motor Car Co., Hartford, Wis., last week shipped 50 trucks to that country.

Cars Preempt Farm Machinery at Wisconsin State Fair

Many Cars Introduced in Mammoth Machinery Hall—A Special "Automobile Day"—Many Factory Men at the Exhibit

MILWAUKEE, WIS., Sept. 19.—The display of motor cars at the 1914 Wisconsin State Fair at Milwaukee from September 14 to 18, inclusive, was the most pretentious exposition of this kind that the State Board of Agriculture, managing the fair, has yet been able to muster. The mammoth concrete Machinery Hall was filled with car exhibits, which crowded out the usual farm gas engine and power machinery displays of former years and obliged these to go into tents adjoining. As a further recognition of the motor car, the board of agriculture set aside one full day as Automobile Day.

This was the first time that the fair board really went out to muster exhibits of cars and the result is so satisfactory that there is no doubt that with a little more work the board can present a motor show each September that will rival or excel the big Milwaukee show in the Auditorium every January. The display last week brought to Milwaukee nearly as many big factory men as the winter show and it cannot be questioned that the state fair show showed better pecuniary results than the winter show can ever hope to, by reason of the enormous number of prospective buyers, farmers and upstate city folk who visit the fair each year.

The fair show served to introduce to Milwaukee and Wisconsin people a large number of cars never seen before or never shown in public expositions prior to this time. This class included the Briscoe, Lewis VI, Haynes light six, the new R. C. H., the new Mitchell light four, the new Imperial light four, the Jeffery Chesterfield six, the new King, Oldsmobile, Moline-Knight, Paige, Chandler, Chevrolet, Reo, Stan-Ford, Cartercar, Regal, KisselKar, Oakland, Overland, Hupmobile, Moline-Knight, Paige, Chandler, Chevrolet, Reo, Stanley steamer, Buick, Case and Detroiter.

The truck division was a feature, and displays were offered by the Stegeman, Menominee, Crown, Jeffery, Reo, Kissel, Overland and Buick. The Jeffery Quad gave exhibitions of its marvelous powers and abilities in mud, sand, ruts and hills in a special plot of ground in the fair park.

Big Interest in Cars at Canada Exposition

TORONTO, ONT., Sept. 10—In spite of the strain imposed by the conflict in which the mother-country is engaged, Canada and Canadian financial conditions are well reflected in the Canadian National Exhibition held in this city.

When the Canadian National Exhibition opened, on August 31, 4 weeks after the declaration of war, Canadian trade anxiously watched with what enthusiasm the public would become interested. Results were most satisfactory. Under normal conditions, about 1,000,000 people visited the exhibition, coming from all parts of Canada. The first week, because of unpleasant weather, the attendance was not up to standard, but the second week motor cars, the barometers of public confidence, indicated by the amount of interest centered upon them that Canada was bearing up and that the automobile trade for the coming year would find it, as ever, an excellent market.

At the close of the exhibition, the exhibitors almost to a man declared themselves very well pleased with results and sales and expressed the belief that the outlook for a good year's business in the automobile trade could not be brighter under the circumstances.

Henderson Bros. Rejoin Cole Co.

INDIANAPOLIS, IND., Sept. 23—*Special Telegram*—C. P. Henderson and his brother, R. P. Henderson are again to be associated with J. J. Cole in the Cole Motor Car Co., this city. The Hendersons will be in charge of sales and advertising as in the past, taking up their new duties October 1. Homer McKee, former sales and advertising manager of the company, is entering the advertising business on his own account and will continue to handle the Cole account in connection with the Mahin Advertising Agency.

46 Cars to Be Shown at St. Louis Show

ST. LOUIS, MO., Sept. 20—At the eighth annual automobile show which will be held at Forest Park Highlands, October 5 to 10, under the auspices of the St. Louis Automobile Manufacturers and Dealers Assn., space has been drawn for the following 46 different makes of gasoline cars:

Oldsmobile, Metz, Empire, Jeffery, National, Lyons-Knight, Havers, Crescent, Studebaker, Paige-Detroit, Premier, Lozier, Mitchell, Hupmobile, Cole, Empire, King, Oakland, White, Jackson, Kissel Kar, Regal, Stevens-Duryea, Meteor, Buick, Pierce-Arrow, Packard, Ford, Dorris, Hudson, Reo, Chevrolet, Locomobile, Chandler, Overland, Marion, Peerless, Mercer, Franklin, Marmon, Winton, Chalmers, Saxon, Stearns-Knight, Auburn and Velie. There will also be shown the following electric vehicles: Waverly, Woods, Rauch & Lang, Baker and Detroit electric.

J. C. Weston Made Tire General Sales Manager

NEW YORK CITY, Sept. 22—Joseph C. Weston has been made general sales manager of the United States Tire Co., succeeding J. D. Anderson, who has resigned. Although the title is new to Weston, who long has been connected with the United States company, latterly as Central District Manager, his duties will not be strange to him, for during the past few months he has been acting general sales manager in the absence of Anderson in Europe. For the present, Anderson will remain in an advisory capacity.

Weston's prominence to the head of the sales organization is a logical one for he has a veteran's experience in the tire business, dating back to the old Morgan & Wright days. For years he was secretary of the Morgan & Wright Co.; when the United States Tire Co. was formed he was appointed Western district manager, his headquarters being in San Francisco. Later, he was appointed Central district manager, succeeding A. I. Philp.

Weston is exceedingly well-liked in the trade both for his universal good nature and ready smile and for his business acumen. There are few men in the tire business who are better known to the trade in general.

General Motors Sells More Cars; Margin of Profit Cut

NEW YORK CITY, Sept. 19—The annual report of the General Motors Co., for the year ended July 31, 1914, shows gross sales of $85,373,303, as compared with $85,603,920 for 1913. The 1914 sales represent the sale of 10 per cent. more cars at correspondingly lower prices. The net profits were $7,947,413, a decrease of $336,727 from last year's figures. The balance after the payment of the accrued interest on the 6 per cent. notes was $7,249,734, or a loss of $209,737, while the undivided profits, after the payment of the preferred dividend, were $6,201,055, a decrease of $209,882. This added to the previous profit and loss surplus made a total of $9,146,434, a gain of $1,472,902. There was charged off $2,457,007, leaving a final profit and loss surplus of $6,689,428, an increase of $3,744,048.

The total value of the real estate, plants and equipment appraised at $21,515,065.26 is entered for a net amount of $15,432,916.58 the difference or $6,082,148.68 being reserved for depreciation. For patents, agreements, etc., there is recorded $471,200; for miscellaneous investments, $352,734.50; the total current and working assets, $28,841,402.02. A total of $7,934,198.14 is marked as good will and is explained as being the excess of the appraised value over the book value of the capital stock of the subsidiary companies, less the reserve.

President Nash in his statement to the stockholders says:

"The net profits of $7,947,412 are, after deducting all expenses of General Motors Co., and also after deducting $944,099, a sum deemed sufficient to cover depreciation of buildings and equipment.

"In view of the considerable undivided surplus income for the year your directors have deemed it wise to write off $972,419 from the book value of patents, agreements, etc., and also to appropriate from surplus the sum of $1,483,208 as an additional reserve for depreciation of plants and equipment. The above amount written off from patents, agreements, etc., comprised the entire sum carried in that account by all subsidiary companies except the McLaughlin Motor Car Co., Ltd. General Motors Co.

owns slightly less than one-half the capital stock of that company, whose agreements, etc., $471,200, are being written off in annual instalments.

"The sole outstanding funded debt of the company July 31, 1914, consisted of $7,852,000 6 per cent. first lien notes, maturing Oct. 1, 1915, being unpaid balance of the original issue of $15,000,000 of these notes dated Oct. 1, 1910. In September, 1913, the company paid the balance of $1,000,000 due Oct. 1, 1913, on account of the sinking fund, and in the spring of 1914 paid in advance the full $2,000,000 sinking fund instalment due Oct. 1, 1914. This $3,000,000, together with interest thereon and a small additional payment from the proceeds of property sold, was applied by the trustee to the purchase of $3,083,000 notes, leaving outstanding $7,852,000.

"Aside from these notes, the only indebtedness of the company and its subsidiary companies on July 31, 1914, consisted of current accounts payable of $3,772,123, composed wholly of the normal obligations for merchandise, etc., and $1,000,247 liabilities accrued, but not due, for pay-rolls, taxes and interest on funded debt.

The income account compares as follows:

	1914	1913	1912
Net profit sub. cos.	†$7,947,413	$8,284,140	$4,838,449
Gen. Motor's share	7,819,968	8,184,053	4,746,757
Interest on notes	570,235	724,581	850,463
Surplus	7,249,734	7,459,471	3,896,293
Preferred dividend	1,048,679	1,048,034	1,040,211
Surplus	*6,201,055	6,410,937	2,856,088

*Equal to 37.57 per cent. on $16,501,783 common stock as compared with 38.90 per cent. on $16,476,783 previous year.

†After deducting manufacturing, selling and administration expenses and maintenance and depreciation.

The profit and loss account follows:

Profit and loss surplus July 31, 1913	$2,945,379
Surplus for 12 months to July 31, 1914	6,201,055
Total	9,146,434
Plants and equipment	1,483,208
Patents, agreements, etc	972,419
Sundry adjustments	1,380
Total deductions	$2,457,007
Profit and loss surplus July 31, 1914	6,689,428

The consolidated balance sheet of General Motors Co. and subsidiary companies directly connected with the manufacture of automobiles and parts, as of July 31, 1914, compares as follows:

Assets

	1914	1913	1912	1911
Real est., plts, eq'p.	$21,515,065	$20,458,978	$19,280,889	$17,632,682
Pat. agreements, etc	471,200	1,508,672	1,871,436	2,049,831
Misc. invest.	352,735	367,063	560,500	854,803
Cash	13,452,663	6,236,251	3,080,921	4,054,844
Notes & accts rec.	3,358,791	3,449,335	4,229,112	4,639,076
Inventories	11,642,370	18,170,907	17,578,366	17,303,715
Prep'd exp.	387,578	412,756	422,736	191,179
*Good will	7,934,198	7,934,198	7,934,198	7,663,938
Total	$59,114,600	$58,538,160	$54,958,159	$54,388,072

*Representing excess of appraised value over book value of stock of sub companies owned, less reserve.

Liabilities

	1914	1913	1912	1911
Pfd. stock	$14,985,200	$14,985,200	$14,936,800	$14,393,500
Com. stock	16,501,783	16,476,783	16,371,183	15,822,330
Funded debt	7,852,000	10,935,000	12,452,000	14,002,000
Outstanding capital stock	573,000	578,000	578,000	1,436,000
Sur. sub. cos.	431,142	409,252	413,839	1,169,527
Accts payable	3,772,123	4,821,774	2,852,022	2,143,847
Liabilities accrued, not due	1,000,247	1,048,970	929,854	641,767
Notes payable	.....	300,000	600,000	.....
Res. for pf. div.	262,241	262,526	261,394	335,848
Reserved for special purposes	7,047,436	5,775,305	4,299,472	3,203,076
Surplus	6,689,428	2,945,379	1,262,595	1,240,175
Total	$59,114,600	$58,538,160	$54,958,159	$54,388,072

July Exports Only $500,000 Less than Year Ago

Exports for 7 Months Also $500,000 Lower —Increase in Exports of Gasoline

WASHINGTON, D. C., Sept. 20—Automobile exports from this country for the 7 months ending July, 1914, have fallen off $500,000 compared with 1913, or from $17,760,733 to $16.818,422, about 3 per cent., though there has been a very slight increase in our export of commercial vehicles. For the respective months of July, 1913 and 1914, exports were $1,736,253 as against $1,249,819, a decrease of almost $500,000.

For the 7 months ending July, 1913 and 1914, gasoline exports, however, have increased 70 per cent., or about $5,000,000, the value going from $7,445,589 to $12,621,406.

Tires fell off from $379,273 in July, 1913, to $341,617 in 1914, the total 7 months showing a decrease of from $2,545,169 to $2,102,092.

Imports of motor cars also decreased in 1914. Comparative figures for the months of July show $81,678 for 1913, as against $26,168 for 1914. The total for the 7 months is $768,521, as against $178,631. Automobile parts imports, however, went from $151,856 to $602,829.

DETROIT, MICH., Sept. 21—The usual semi-annual dividend of 3 1-2 per cent. on its preferred stock has been declared by the General Motors Co. It will be paid November 1 to stock on record October 15. The company will mail checks.

Imports	July— 1913 No.	July— 1913 Value	July— 1914 No.	July— 1914 Value	Seven Months Ending July— 1913 No.	Seven Months Ending July— 1913 Value	Seven Months Ending July— 1914 No.	Seven Months Ending July— 1914 Value
Automobiles, and Parts of:								
Automobiles.....No. dut.	37	$81,678	13	$ 26,168	320	$768,521	104	$178,631
Parts of (except tires)....dut.	..	17,510	..	104,338	...	151,856	...	602,829
BY COUNTRIES								
France.....No.	16	34,085	4	8,543	120	276,702	46	88,709
Germany.....No.	6	13,880	3	6,755	72	191,274	9	15,128
Italy.....No.	3	6,831	1	1,000	50	102,204	18	22,798
United Kingdom.....No.	3	11,817	3	4,072	27	83,349	13	28,979
Other countries.....No.	9	15,065	2	5,798	51	114,992	18	23,017
Total.....No.	37	81,678	13	26,168	320	768,521	104	178,631

Exports	July— 1913 No.	July— 1913 Value	July— 1914 No.	July— 1914 Value	Seven Months Ending July— 1913 No.	Seven Months Ending July— 1913 Value	Seven Months Ending July— 1914 No.	Seven Months Ending July— 1914 Value
Automobiles:								
Commercial...	44	$103,612	50	$106,400	662	$1,150,649	443	$648,241
Passenger.....	1,720	1,632,641	1,265	1,143,419	16,528	16,610,084	18,499	16,170,181
Total.....	1,764	1,736,253	1,315	1,249,819	17,190	17,760,733	18,942	16,818,422
Parts	.....	$394,850	.....	$420,975	$2,893,753	$3,530,777	.....	$3,911,018
BY COUNTRIES								
Automobiles:								
France.....	47	33,281	16	15,803	567	429,133	1,044	625,636
Germany.....	132	98,420	16	17,364	761	678,462	1,063	799,552
Italy.....	39	31,932	16	8,640	222	198,300	228	147,388
United King.	300	232,792	227	183,988	2,970	2,250,040	4,967	4,087,763
Other Europe.	166	148,275	152	130,227	1,298	1,128,107	2,366	1,876,114
Canada.....	207	348,174	257	386,234	4,733	6,289,041	3,356	4,069,621
Mexico	30	39,487	2	1,647	142	255,287	54	65,974
West Indies	35	33,170	40	35,033	286	286,838	320	286,063
South America	222	247,544	90	62,288	1,732	1,963,328	872	709,239
British Oceania	277	240,734	311	237,780	1,873	1,827,690	2,587	2,233,471
Asia-Oceania.	154	144,472	115	121,896	1,445	1,410,087	1,179	1,110,001
Others.....	155	137,972	73	48,919	1,161	1,044,420	906	807,600
Total.....	1,764	1,736,253	1,315	1,249,819	17,190	17,760,733	18,942	16,818,422

	July— 1913 Quantity	July— 1913 Value	July— 1914 Quantity	July— 1914 Value	Seven Months Ending July— 1913 Quantity	Seven Months Ending July— 1913 Value	Seven Months Ending July— 1914 Quantity	Seven Months Ending July— 1914 Value
Tires:								
Belgium.....	.....	$15,137	.....	.....	.....	$98,769	.....	$301
Germany.....	.....	36,123	.....	$6,090	.....	421,564	.....	81,917
England.....	.....	153,819	.....	156,961	.....	776,118	.....	889,793
Canada.....	.....	85,001	.....	99,514	.....	807,424	.....	649,764
Mexico.....	.....	13,165	.....	4,218	.....	77,397	.....	32,140
Philippines....	.....	16,195	.....	10,953	.....	74,867	.....	67,106
Others.....	.....	59,833	.....	63,881	.....	289,030	.....	381,071
Total.....	.....	379,273	.....	341,617	.....	2,545,169	.....	2,102,092
*Gasoline:**	Gallons		Gallons		Gallons		Gallons	
Belgium.....	.....	.....	865,928	104,252	721,989	43,319	2,688,528	322,714
France.....	.....	.....	6,444,140	713,256	.....	.....	18,912,827	2,313,903
Germany.....	.....	.....	.....	.....	.....	.....	3,753,361	464,410
Italy.....	.....	.....	.....	.....	.....	.....	1,650,245	191,937
Netherlands...	.....	.....	.....	.....	3,494,189	461,616	3,950,000	493,750
United King.	.....	.....	3,731,682	373,258	.....	.....	21,434,074	2,324,160
Other Europe.	549,250	91,213	1,450,750	179,903	13,044,294	1,661,863	4,276,701	591,294
Canada.....	4,511,012	643,790	2,780,343	254,600	21,898,262	2,939,307	15,371,129	1,616,582
Argentina....	300,000	41,850	670,145	113,517	777,099	135,703	9,762,802	1,665,302
Brazil.....	2,213,425	408,312	475,890	84,684	8,073,448	1,456,965	2,252,523	419,305
British Oceania	.....	.....	356,220	61,119	146,001	24,103	4,361,344	852,546
Others.....	481,106	100,749	2,106,760	296,444	3,527,479	722,713	7,979,543	1,365,503
Total.....	8,054,793	1,285,914	18,881,858	2,181,033	51,682,761	7,445,589	96,393,077	12,621,403

* Not stated for periods in which no figures are shown.

Mayor Mitchel Vetoes Separator Repeal

NEW YORK CITY, Sept. 21—The ordinance requiring the use of separators in garages, to keep gasoline and oils from leaking into the sewers, is still in effect, the Mayor having recently vetoed the bill placed before him by the Board of Aldermen, which would have repealed this ordinance.

The only alternative for the garagemen and dealers, who are conducting the fight, is to take the matter again to the Board of Aldermen and ask that they pass a new bill over the veto of the Mayor. To do this a favoring vote of two-thirds is necessary.

Those fighting the bill claim that little or no gasoline leaks into the sewers, and what does is greatly diluted by water. That the explosions which occur are caused by illuminating gas leaks, and that furthermore, although the separators cost from $500 to $1,000 each, they are not efficient in overcoming the evil, if it does exist.

Mayor Mitchel, basing his ideas on the report of the fire department and contentions of the sewer employees, maintains that the ordinance must be carried out.

Detroit Police May Regulate Taxi Stands

DETROIT, MICH., Sept. 18—A new ordinance will be submitted to the city council next week, having already been adopted by the council committee on ordinances, and if finally passed will enable the police commissioner to decide where taxicab and automobile stands may and may not be located.

The commissioner thinks that property owners have no right to receive compensation from automobile or taxicab owners and it has been shown that many derive a large revenue therefrom. It is claimed that one downtown property owner has been receiving about $1,500 a year from the renting of space in front of his property in a leading thoroughfare.

Another ordinance will be submitted regulating the rates to be charged for motor cars rented by the hour. The maximum fare is to be $3.00 an hour for a five-passenger car and $4.00 per hour for car seating more people.

Standard Not Guilty of Monopoly

NEW YORK CITY, Sept. 21—The Standard Oil Co. has not violated the Seven Sisters act passed in the State of New Jersey while President Wilson was governor and tending to check monopoly. The Crew-Levick Co., Jersey City, an independent, charged that the Standard was charging a low rate where there was competition and a high rate where there was none. The court, in arriving at its decision, took into consideration the competition of the Gulf Refining Co., which has been engaged in a not entirely one-sided price war with the Standard company and has taken some of the latter's customers.

Market Reports for the Week

No important changes occurred in this week's market reports. Tin has a fluctuating week, its highest quotation being at $32.00 and its closing price at $31.65, at a gain of $0.40 per 100 pounds. Copper exports have been normal. Last week exports of coper from New York City and Baltimore aggregated 1,737 tons. Since the first of September total exports from Atlantic ports have amounted to 11,897 tons. Lead is quiet and barely steady. A reduction was announced in Kansas petroleum from $0.65 to $0.55 per barrel.

Material	Wed.	Thurs.	Fri.	Sat.	Mon.	Tues.	Week's Changes
Antimony	.10	.10	.10	.10	.09	.09	—.01
Beams & Channels, 100 lbs.	1.31	1.31	1.31	1.31	1.31	1.31	.....
Bessemer Steel, ton	20.50	20.00	20.00	20.00	20.00	20.00	.....
Copper, Elec., lb.	.12	.12	.11⅞	.11⅞	.11⅞	.11⅞	—.00⅛
Copper, Lake, lb.	.12¼	.12¼	.12⅛	.12⅛	.12⅛	.12⅛	—.00⅛
Cottonseed Oil, bbl.	5.80	5.81	5.85	5.77	5.84	5.60	—.20
Cyanide Potash, lb.	.32	.32	.32	.32	.32	.32	.....
Fish Oil, Menhaden, Brown	.40	.40	.40	.40	.40	.40	.....
Gasoline, Auto, bbl.	.13	.13	.13	.13	.13	.13	.....
Lard Oil, prime	.93	.93	.93	.93	.93	.93	.....
Lead, 100 lbs.	3.85	3.85	3.85	3.85	3.85	3.85	.....
Linseed Oil	.60	.60	.60	.60	.60	.58	—.02
Open-Hearth Steel, ton	20.50	20.00	20.00	20.00	20.00	20.00	.....
Petroleum, bbl., Kans., crude	.65	.65	.65	.65	.65	.55	—.10
Petroleum, bbl., Pa., crude	1.45	1.45	1.45	1.45	1.45	1.45	.....
Rapeseed Oil, refined	.82	.82	.82	.82	.82	.82	.....
Rubber, Fine Up-River, Para	.68	.66	.65	.65	.65	.65	—.03
Silk, raw, Ital.	..	4.60	..	..	4.60	..	.....
Silk, raw, Japan	..	3.80	..	..	3.80	..	.....
Sulphuric Acid, 60 Baume	.90	.90	.90	.90	.90	.90	.....
Tin, 100 lb.	31.25	31.50	31.62½	31.75	32.00	31.65	+.40
Tire Scrap	.05	.05	.05	.05	.05	.05	.....

Lozier Co. Charged with Insolvency

DETROIT, MICH., Sept. 20—Lee E. Joslyn, referee in bankruptcy, was to-day appointed custodian of the property of the Lozier Motor Co. by U. S. District Court Judge Tuttle, pending the hearing to take place next Wednesday, when it will be decided if the company should be declared bankrupt or placed in the hands of a receiver.

An involuntary petition was filed by three parts makers. According to the Lozier company's attorney, the company does not admit itself insolvent. According to a statement of the company's standing in December, 1913, the total assets then amounted to $4,067,051 and the total liabilities to $1,572,667.

The capital stock of the company consists of $2,500,000 in common and $500,000 preferred 7 per cent.

Cotton Traded for Cars in Georgia

ATLANTA, GA., Sept. 18—Confident that business conditions in the country are improving steadily and that the future demand for cotton will be exceptionally heavy and that consequently there will be big sales, the Forsythe Motor Co., of this City, distributor of the Stearns-Knight cars, will accept cotton in payment for automobiles. The company has been running the following advertisement in a local paper:

Forsythe Motor Co., distributor of Stearns-Knight cars, will accept properly certified warehouse receipts for cotton, upon a basis of not less than 10 cents a pound, middling cotton, in settlement for automobiles.

This cotton will be held until February 1, 1915, and if at that time it can be sold for more than 10 cents a pound the original owner will receive the increase, less the cost for holding.

If the cotton does not sell for as much as 10 cents a pound we will bear the loss.

We offer the following cars for immediate delivery: Five-passenger National, seven-passenger Fiat limousine, five-passenger Stearns-Knight, four-passenger Stearns-Knight, Pope-Toledo roadster, Babcock electric, seven-passenger Cole.

Nebraska Wheat, 142 Per Cent. of Average

OMAHA, NEB., Sept. 20—The United States National Bank of Omaha has just compiled its annual estimate of the size and value of the crops raised this year within the boundaries of Nebraska. These figures were taken in conjunction with the reports of the agricultural departments of the United States and Nebraska.

The figures show that the wheat crop that has already been housed is 142 per cent. of the five-year average and is 69,735,000 bushels. The advance in prices, due to the European war, gives an added value of $35,000,000 to the wheat alone.

The big corn crop, although only 82 per cent. of a five-year average, is still more than 150,000,000 bushels, and the war prices have advanced the value of this crop something like $30,000,000. Then the demand for oats, alfalfa, hay etc., for the horses of the armies of Europe has sent prices away up above normal and has added a number of millions of dollars to the Nebraska farmers' bank account.

Hudson's August Shipment 1,697 Cars

DETROIT, MICH., Sept. 21—During August, 1914, the Hudson Motor Car Co., has shipped 1,697 Hudson cars, or 897 more than during August, 1913. During the first two weeks of September of this year shipments totalled 1,250 cars or five times as many as during the corresponding period of 1913. Everything indicates a continued increased activity at the Hudson plant and by October 1, it is planned to have between 2,700 and 3,000 cars shipped.

CHICAGO, ILL., Sept. 21—J. F. Reddick, formerly a director of publicity with the Goodyear Tire & Rubber Co., Akron, O., has been appointed advertising manager of the Stromberg Motor Devices Co., of this city.

Marmon on High Gear 355 Miles in New England

BOSTON, MASS., Sept. 19—Frank E. Wing, New England, distributor of Marmon cars, made a new touring record in the demonstrator of the 1915 medium six this week. He drove

the car from Boston through to Bretton Woods, up over Tug-of-War hill in Crawford Notch, and then down to Boston again through the other route via Merrimac Valley, a distance of 355 miles, with the gear speed shift lever sealed in high gear. It was the first time any car has ever attempted the feat. The car carried four people, and was not prepared especially for the trip. The party left Boston at 5.20 a. m., Wednesday and reached Bretton Woods at 11 p. m., starting back at 12.30 reaching Boston at 7.15. With the time taken out for breakfast at Portsmouth, filling with gasoline at Rochester and Franklin and the time spent at Bretton Woods, the actual time was about 11 hours. Tug-of-War hill in Crawford Notch is the famous hill that broke the hopes of a lot of contestants, in the early Glidden tours, who had to be towed up.

On the Glidden tours the trips to Bretton Woods from Boston was divided into 4 days, 2 up and 2 down, with night stops at Portsmouth and Concord, half way cities, but Mr. Wing did it in a daylight to dusk trip, and had he wanted to speed could have made it in 10 hours. He averaged about 11 miles to the gallon of gasoline.

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2-Cent Postal Rate Suggested for S. A.

WASHINGTON, D. C., Sept. 21—The Post Office Department is actively co-operating to stimulate trade between the United States and South and Central America. Postmaster-General Burleson has under consideration a plan making the 2-cent rate for letter postage effective throughout the Western Hemisphere. Today he issued an order directing the Third Assistant Postmaster-General to suggest immediately to the representatives of the Latin-American countries, with which the United States does not now transact money order business, the desirability of concluding conventions for that purpose. These countries are Argentina, Brazil, Columbia, Dutch Guiana, Paraguay and Venezuela, in South America and Guatemala, Nicaragua and Panama in Central America.

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E. V. A. A. Completes Convention Program

NEW YORK CITY, Sept. 21—The program of the Fifth Annual Convention of the Electric Vehicle Assn. of America, which will be held on October 19, 20 and 21 at the Hotel Bellevue-Stratford, Philadelphia, Pa., is complete.

Some of the articles that will be read at the convention are as follows: October 19, afternoon, "Progress of the Electric Vehicle," by J. H. McGraw; "Electric Vehicles in Parcel Post Service," by W. P. Kennedy; in the evening, F. Nelson Carle will speak on "Special Applications of Electric Trucks; October 20, morning, "Electric Vehicle Performance," R. B. Grove; October 20, afternoon: "Electric Fire Apparatus," Chief G. S. Walker; October 21, morning: "The Design and Performance of Electric Vehicle Motors," H. S. Baldwin; and October 21, evening, "European Development of the Electric Vehicle Industry," P. D. Wagoner.

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Regular Vacuum Oil Dividend

NEW YORK CITY, Sept. 22.—The Vacuum Oil Co. has declared the regular semi-annual dividend of 3 per cent., payable October 31, to stock of record October 15.

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NEW YORK CITY, Sept. 19—The Willys-Overland Co. declared a regular quarterly dividend of 1 3-4 per cent. preferred, payable October 1, to stock of record of September 22.

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HARTFORD, CONN., Sept. 20.—The Colonial Auto Co., Studebaker distributor, has adopted the 50-hour-free service plan. All purchasers of 1915 Studebakers will be given coupon books representing 50 hours of free service. The plan originated with Russell P. Taber, the Reo distributor.

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Sphinx Small Car for $695

NEW YORK CITY, Sept. 22—The Sphinx Motor Car Co., York, Pa., has announced a five-passenger touring car selling for $695 with standard equipment, including an electric generator and starter, electric lights, windshield, and spare rim. Wire wheels will be put on for $25 extra.

This new car has a 112-inch wheelbase and a tread of 54 1-2 inches, with a four-cylinder monobloc motor, delivering 28 horsepower. This motor has enclosed valves, detachable head and a camshaft with integral cams. The bore is 3 3-8 inches and the stroke 5 inches. It is claimed that the car will give 25 miles to the gallon of gasoline, and for oil, 250 miles per quart.

Cantilever springs, both front and rear, are used. Thermo-syphon cooling, shaft drive and a streamline body are features.

Operations were started this week in the large three-story brick factory building, North Duke street and the Pennsylvania railroad, formerly occupied by the Hart-Kraft Motor Car Co.

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A Child's Seat for Saxon's

DETROIT, MICH., Sept. 18—A novel seating arrangement has been provided by the Saxon Motor Co., which gives accommodation in the Saxon light car for a child in addition to two adult persons.

The child's seat is an additional equipment to the new cars and is placed near the dashboard and fronts the two adult seats. It is neat and compact and when not in use may be closed. It does not interfere with either of the other passengers. It is provided at a cost of $10.

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Allen Co. Elects; To Build 2,000 Cars

FINDLAY, O., Sept. 19.—The Allen Motor Co., Fostoria, O., has had its annual election of officers, resulting as follows: President, E. W. Allen; vice-president, Gratton Baker; second vice-president, J. E. Wright; third vice-president, P. J. Cristy; treasurer and general manager, W. O. Allen; secretary, A. E. Wyant; general superintendent, L. A. Summers. The company's business the past year amounted to $800,000, and it will complete 2,000 cars this year.

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Purchases Cotton for Automobile Dealers

TOLEDO, O., Sept. 21—John N. Willys, president of the Willys-Overland Co. has purchased a bale of cotton for each of the 400 Overland dealers in the South. Mr. Willys says that it is his intention to buy an additional bale of cotton for each Overland car purchased during the 2 months ending November 17.

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BOSTON, MASS., Sept. 23—A meeting of stockholders of the Walpole Tire & Rubber Co. has been called for September 29, when it is understood directors will signify their intention of serving in that capacity if the company is reorganized and taken out of the hands of receivers.

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New Pullman for $695

YORK, PA., Sept. 22—Announcement was made this week by the Pullman Motor Car Co. of a new model, to sell at $695. It is almost identical in design with the Light Six 6-48 with refinement details, only much smaller. The car has a four-cylinder engine capable of developing about 30 horsepower, one man top, cantilever springs, demountable rims, electric lights and electric starter. It is the plan to build the new model in a touring car and roadster. Deliveries of the new car will begin to be made in limited quantities about November 1.

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NEW YORK CITY, Sept. 21—H. W. Hayden, general manager of the Pullman Motor Car Co., announces he has completed arrangements with the Drouet & Page Co., Inc., to represent the Pullman in the New York territory, including northern New Jersey, Greater New York, Westchester, Putnam and Orange counties.

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1915 Paterson Complete, $1,485

FLINT, MICH., Sept. 14—The W. A. Paterson Co., announces that the price of its 1915 six-cylinder car is $1,485, completely equipped. The motor is a Northway cast in block with 3 1-2-inch bore, 5-inch stroke, having L-head valves. The carbureter is a Stromberg and the Delco starter, lighting system and magneto is used. The wheelbase is 124 inches and the wood wheels are fitted with 34 by 4-inch tires, both on the front and rear. The car will be equipped with left drive and center control. The axles are Weston-Mott, floating. The equipment will be standard and includes a motor driven air pump.

Since the announcement last week of the new four-cylinder Paterson the company has decided that it will build these cars with a floating rear axle instead of a semi-floating and that a Stromberg carbureter will be used.

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Hearing Against Pope Co. Oct. 1

HARTFORD, CONN., Sept. 20.—Richard J. Goodman, a committee of the superior court, is to hear the claims presented against the Pope Manufacturing Co. and has made the following assignment of claims hearings: Thursday, October 1, Hancock Mfg. Co. and the Mogul Co.; Monday, October 5, Edwin J. Blake; Monday, October 12, the claims of Albert L. Pope; C. E. Walker and W. C. Walker.

New York City Trade Boosters

Assemblage of Big Village Boosters and friends at Fred. Wagner's farm at Smithtown,

Upper — Imbibing refreshments at the second station in the novel cigar-drink - signature gymkhana

Middle—The New York baseball team. From left to right, standing — H. A. Bonnell, umpire; E. D. Studebaker, D. Swandee, E. J. Sullivan, R. H. Johnston, Captain; C. Doty, J. Bestar, Geo. W. Greiner; sitting, T. W. Sneed, W. C. Poertner

Lower — The shoe race

Annual Outing of Big Village Boost Game—Five Motor Car Con

NEW YORK CITY, Sept. 19—Following the custom established several years ago, that portion of the New York City automobile trade which goes to make up the organization known as the Big Village Motor Boosters, held its annual outing at Fred. Wagner's Long Island farm at Smithtown today. Nearly 200 dealers and their guests assembled. They were conveyed to the picnic ground in 43 automobiles.

Automobile Events Prominent

The program for the day was a lengthy one and in contradistinction to other programs of a similar kind, contained a fair proportion of events which required the use of automobiles. Of the fifteen contests which were decided, five were for motor car drivers. These were as follows: Forward and reverse race in which the driver was required to drive forward about 50 feet, reverse and drive backwards to the finish line; speed guessing contest, in which the speedometer was covered and the driver was required to cover a specified distance in a secret time; gymkhana race in which the driver drove to station 1, removed his coat and lighted a cigar, drove to station 2 and uncorked and drank a bottle of liquid refreshment, drove to station 3 and signed his name, put his coat on and buttoned it and drove to station 4, the finish; potato race in which a companion to the driver dropped six potatoes into as many baskets, the one having the greatest number of potatoes in the basket and completing the race in the shortest time to win; slow speed on high gear race.

N. Y. Dealers Win Baseball Game

Between these various automobile contests there were 10 athletic events and a baseball game between a team of New York dealers and a team of Brooklyn dealers. The New York men won, the final score being 10 to 1. Following the athletic program, a clam-bake brought the day to a close.

The summary:

Wheelbarrow race: First heat won by C. Smith and G. Sullivan; second heat, E. G. Baker and Isacson; third heat, S. Marks and Arthur Haines; fourth heat, D. Beecroft and N. Lazarnick. Final won by S. Marks and Arthur Haines.

Golf driving contest—Won by R. Godwin

Caper on Starter Wagner's Farm

Long Island, Saturday, Sept. 19. Nearly 200 dealers and their guests were there

ers Draws 200 Dealers—Baseball tests — Ten Other Events

(200 yards); second, G. Sullivan; third, Alfred Keeves.

Fat man's race, 50 yards—Won by M. A. Noonan; second, F. G. Hill; third, J. Kirk. Time 5 sec.

Three-legged race—First heat won by E. D. Studebaker and J. S. Bestar; second heat, J. Brietenbach and G. Arbogast; third heat, M. W. Colwell and E. H. Burgin. Final, J. Brietenbach and G. Arbogast; second, E. D. Studebaker and J. S. Bestar.

Fifty-yard dash—Won by E. D. Studebaker; second, G. Arbogast. Time, 5 1-5 sec.

Sack race, 50 yards—Won by Gene Sullivan; second, G. Arbogast. Time 12 2-5 sec.

Automobile Sports Hotly Contested

Forward and reverse automobile race—Won by A. Hartog (Packard) 15 2-5; second, H. B. Mall (National), 16 2-5; third, Geo. B. McCutcheon (National coupé), 17 sec.; fourth, J. Brietenbach (Chandler), 17 4-5; fifth, M. E. Le Bon (Jeffery) 20 1-5.

Secret time contest—Won by H. B. Mall (National), time, 22 sec.; second, A. Hartog, (Packard), time 21 4-5 sec.; third, R. H. Johnston (White), time, 23 3-4 sec. Secret time, 22 sec.

Gymkhana race—Won by Fred. Miller (Packard), time, 1:26 4-5; second, tie, W. C. Poertner (National), and H. B. Mall (National), time, 1:24 4-5; third, D. Beecroft, (White), time, 1:45 3-5.

Shoe race—Won by E. C. Blake; second, D. Beecroft.

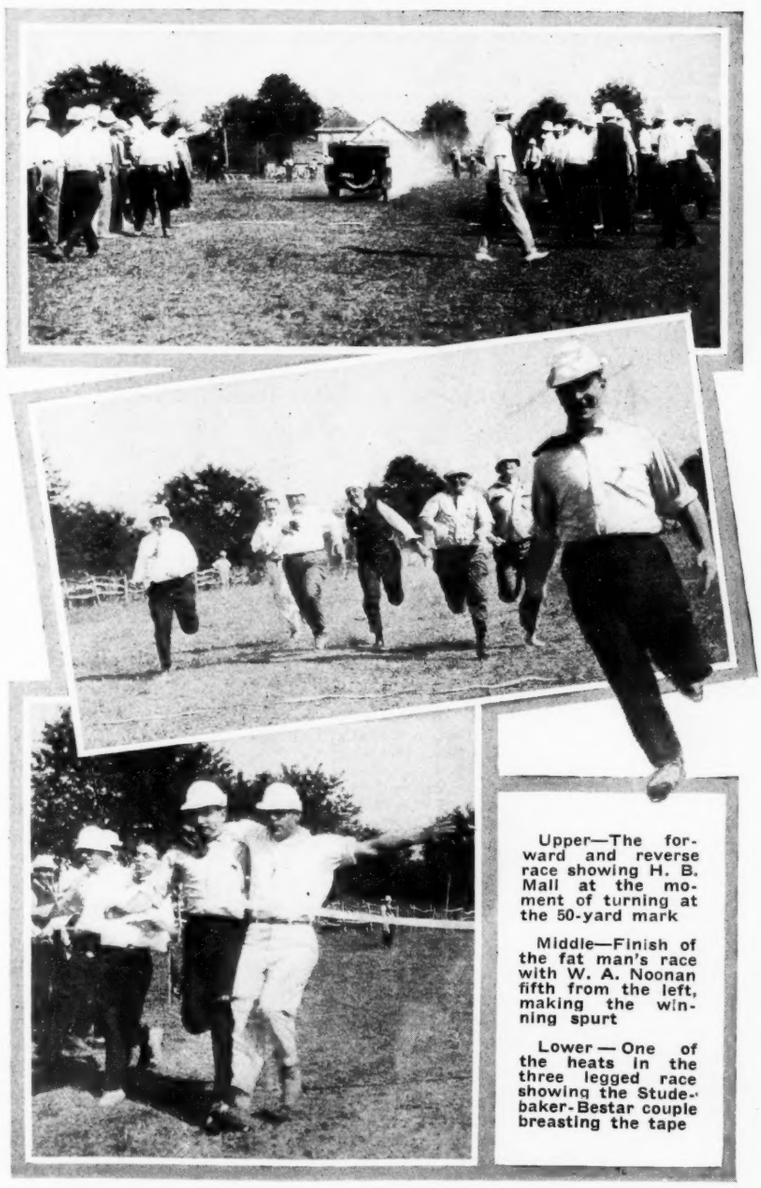
Slow speed on high gear—Won by Chas. A. Hopfensack (Chandler), 23 2-5 sec.; second, E. C. Blake (Packard), 20 3-5 sec.; third, R. H. Johnston (White), 20 1-5.

Geo. Robertson Cup—Won by W. Parkinson.

Poertner Wins Potato Race

Potato race—Won by W. C. Poertner, driving a Jeffery and with Roebensteik as bomb thrower, won, his time being 14 4-5 seconds, with 5 potatoes in the baskets.

Throughout the whole of the program good fellowship prevailed. The staging of the Booster's outing was placed in the hands of a number of committees, who gave freely of their time that the event might be a success. The commissary department was under the direction of H. A. Bonnell.



Upper—The forward and reverse race showing H. B. Mall at the moment of turning at the 50-yard mark

Middle—Finish of the fat man's race with W. A. Noonan fifth from the left, making the winning spurt

Lower — One of the heats in the three legged race showing the Studebaker-Bestar couple breasting the tape

Burman and Oldfield Smash Mile Track Records

ST. LOUIS, MO., Sept. 20—Barney Oldfield, driving a Fiat Cyclone on the Maxwellton mile track in this city, today broke two existing records when he covered the mile in 44 seconds flat, and drove 5 miles in 3:40 2-5. The previous existing mile record of 46:40 was made by Oldfield in a Christie at Bakersfield, Cal., August 27 last year.

The previous 5-mile record was held by Louis Disbrow in a Simplex and was 4:06:58, made at Cleveland, September 14, 1912.

Oldfield's new records were made today at the postponed Labor Day meet of the St. Louis Automobile Racing Assn., which has promoted several track meets during the season. The Maxwellton track can scarcely be considered a conventional 1-mile dirt track in that it is more nearly circular than the ordinary track. Its curves have a radius of 675 feet, whereas the ordinary radius of the mile track is 400 feet. The curves are banked to 8 1-2 degrees. Timing was done by the Stewart Indianapolis timer, which was leased for the occasion. It will remain for the Contest Board at the American Automobile Assn. whether Oldfield's two records will be allowed, but it would seem that there should not be any reason why they should not. The meet was under the direction of W. P. N. Stevens, Contest Board representative from Kansas City, Mo., who is entirely familiar with track contests.

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SPRINGFIELD, ILL., Sept. 19—Burman made mile dirt-track records today at the Illinois State Fair, when he traveled 20 miles in 17:10 3-5 and 25 miles in 21:17 3-5. These records for a circular track were formerly held by Louis Disbrow, who made 20 miles in 17:57 at San José, Cal., and by Barnes, who did 25 miles in 22:07 at Portland, Ore.

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$7,000 Prizes at Oklahoma Fair Races

OKLAHOMA CITY, OKLA., Sept. 19—With $7,000 in prize money, Oklahoma City offers a program of dirt track automobile racing at the state fair beginning Sept. 19 and ending Oct. 3, with Louis Disbrow, Heine Ulbricht, Fred Horey, Johnny Raimey, Joe Cleary, former Texas Ranger, "Mad Lou" Heineman and Eddie Hearne scheduled to start.

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Elkhart Parades at Lincoln Highway Dedication

INDIANAPOLIS, IND., Sept. 21—A section of the Lincoln Highway, which has just been improved, was formally dedicated at Elkhart last Wednesday. This is five-eighths of a mile long and is the first section in Indiana to be completed. As a part of the program, there was a parade of 286 motor cars over the pavement.

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Studebaker's Sales Triple in 2 Weeks of September

DETROIT, MICH., Sept. 21—As an evidence of national prosperity the Studebaker Corp., has made public the record of the actual sales made by its 13 branches in the country during the first 2 weeks of this month. The result shows sales aggregating $1,118,447 as against a total of $373,411 for the corresponding 2 weeks in 1913. There is thus a gain this year of $745,066, and the total increase of business is 300 per cent.

The sales made by each branch during the first 2 weeks of September this year and last year were as follows:

Branch	1914	1913
Chicago, Ill.	$ 278,433	$ 72,570
Minneapolis, Minn	148,464	55,825
Kansas City, Mo.	139,386	26,554
Philadelphia, Pa.	76,761	12,735
Omaha, Neb.	69,306	14,463
Boston, Mass.	67,553	25,685
Dallas, Texas	56,901	16,269
Atlanta, Ga.	51,168	11,882
St. Louis, Mo.	50,505	46,073
New York, N. Y.	46,018	25,344
San Francisco, Cal	45,571	30,776
Portland, Ore.	45,071	13,354
Detroit, Mich.	43,340	20,381
Total	$1,118,447	$373,411

While these figures show the results of only one manufacturer, they give a fair idea of the business conditions in certain parts of the country. Thus it will be seen at once that it seems that in the Western States the demand for motor cars is much heavier than in the East.

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One Six—National Offering for 1915

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travel has necessitated lengthening the shaft .25 inch.

On the stock cars the wheels are wood although wire-wheel equipment will be fitted at an additional cost of $125. The tires are 36 by 4.5. The drive is taken through the main leaf of the rear spring and is heavily constructed for that purpose. Easy riding is insured by a comparatively large number of thin leaves. There are eight leaves in the cantilever. The springs are linked at the forward end and swivelled at the center; that is, the fixed point of the spring is at its center and the play is given at the extremities. The tensile strength of the steel used is 120,000 pounds to the square inch. The spring measures 53 inches over all.

The Automobile Calendar

Sept. 15-Oct. 11...New York City, Commercial Tercentenary Celebration

Sept. 23-Oct. 3....Oklahoma City, Okla., Show, Oklahoma Automobile Association.

Sept. 26.....Kalamazoo, Mich., 100-Mile Track, Inter-State Fair.

Sept. 27.....Pleasanton, Cal., Track Meet, Alameda County Fair Assn.

Sept. 28-Oct. 3....Salem, Ore., Automobile Show, Oregon State Fair.

Oct. 3-10.....Cincinnati, O., Show.

Oct. 3.....Fresno, Cal., Track Meet, Fresno Co., Agricultural Assn.

Oct. 4.....St. Louis, Mo., Automobile Show, Auto Manufacturers' and Dealers' Assn.

Oct. 5-12.....St. Louis, Mo., Show, Forest Park Highlands.

Oct. 7-8-9-10.....Detroit, Mich., First Truck Convention of Motor Truck Manufacturers', Dealers' and Owners' Organization; promoter, Motor Truck Club of America.

Oct. 7-17.....New York City Electric Vehicle Show, Grand Central Palace.

Oct. 10.....Medford, Mass., Track for Light Cars, Combination Park.

Oct. 10-17.....Boston, Mass., New England Light Car and Cyclecar Show, Horticultural Hall.

Oct. 17.....Los Angeles, Cal., Show, Shrine Auditorium.

Oct. 17-24.....Pittsburgh, Pa., Automobile Show, Auto Dealers Assn., Inc.

Oct. 17-Nov. 1....Dallas, Tex., Show, State Fair Grounds, Dallas Automobile Dealers' Assn.

Oct. 19, 20, 21....Philadelphia, Pa., Elec. Veh. Assn's Convention.

Oct. 19-26.....Atlanta, Ga., American Road Congress of the American Highway Assn. and the A. A. A.

Oct. 28-31.....Milwaukee, Wis., Convention, Northwestern Road Congress, Auditorium.

Nov.....El Paso, Tex., Phoenix Road Race, El Paso Auto Club.

Nov. 8-9.....El. Paso to Phoenix, Ariz., Automobile Race.

Nov. 8-11.....Shreveport, La., Track Meet, Shreveport Auto Club.

Nov. 26.....Corona, Cal., Road Race, Corona Auto Assn.

Dec. 1-4.....New York City, Annual Meeting of the American Society of Mechanical Engineers.

Jan. 2-9.....New York City, Annual Automobile Show, Grand Central Palace

Jan. 3-10.....Buenos-Aires, Argentina, Grand Prize of Argentina.

Jan. 9-16.....Philadelphia Automobile Show.

Jan. 23-30.....Chicago, Ill., Automobile Show, First Regiment Armory.

Jan.30-Feb. 6....Minneapolis, Minn., Show, National Guard Armory, Minneapolis Automobile Trade Assn.

Feb. 15-20.....Omaha, Neb., Show, Auditorium, C. G. Powell.

Feb. 22.....San Francisco, Cal., Vanderbilt Cup Race, Panama-Pacific Exposition Grounds; Promoter, Panama-Pacific Exposition Co.

Mar. 6-13.....Boston, Mass., Show, Mechanics Bldg., Boston Auto Dealers Assn. Boston Commercial Motor Veh. Assn.

Mar. 7.....San Francisco, Cal., Panama-Pacific Exposition, Grand Prize Race, Panama-Pacific Exposition Grounds; Promoter, Panama-Pacific Exposition Co.

Mar. 14.....San Francisco, Cal., Panama-Pacific Cup Race, Panama-Pacific Exposition Grounds; Promoter, Panama-Pacific Exposition Co.